Crooked Lake Aquatic Vegetation Management Plan 2007-2011

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Executive Summary

Aquatic Control was contracted by the Crooked Lake Association (CLA) to complete aquatic vegetation sampling in order to create a lakewide, long-term integrated aquatic vegetation management plan. Crooked Lake is located 3 miles northwest of Angola in Steuben County, Indiana. This plan was created in order to more effectively document and control nuisance aquatic vegetation within the lake. This plan was also created as a prerequisite to eligibility for LARE program funding to control nuisance exotic vegetation.

Aquatic vegetation is an important component of Indiana Lakes. Aquatic vegetation provides fish habitat, food for wildlife, prevents erosion, and can improve overall water quality. However, as a result of many factors, this vegetation can develop to a nuisance level. Nuisance aquatic vegetation, as used in this paper, describes plant growth that negatively impacts the present uses of the lake including fishing, boating, swimming, aesthetic, and lakefront property values. The primary nuisance species within the Crooked Lake is the invasive exotic plant Eurasian watermilfoil (*Myriophyllum spicatum*). The negative impact of this species on native aquatic vegetation, fish populations, water quality, and other factors is well documented and will be discussed in further detail. Curlyleaf pondweed (*Potamogeton crispus*) is another invasive exotic species that is present in Crooked Lake at nuisance levels in spring and early summer.

The primary recommendation for plant control within the Crooked Lake chain involves the use of systemic herbicides to selectively control Eurasian watermilfoil throughout the lake. More specifically, 2,4-D and/or Renovate herbicide should be used for selective control of milfoil in the first and second basins and fluridone for selective control in the third basin. This type of treatment should preserve and enhance the population of native vegetation and relieve nuisance conditions created by Eurasian watermilfoil. Ideally, the objective is to eliminate this exotic species, but in a waterbody of this size, combined with inflow from other Eurasian watermilfoil infested lakes, this objective is likely not obtainable. A more realistic objective for this treatment is to maintain Eurasian watermilfoil below 5% frequency of occurrence in Crooked Lake and reduce the negative impacts created by this species. Control of curlyleaf pondweed will occur in the third basin following the fluridone treatment. However this species will return in 2008 and should be considered for control if funds are available. Currently, there is a relatively diverse native plant population present in Crooked Lake. Steps should be taken to maintain and enhance this valuable native plant population. The Association is also exploring the possibility of establishing eco-zones which should help reduce wave action thus further enhancing native plant populations.

Acknowledgements

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1.0 INTRODUCTION

Aquatic Control was contracted by the Crooked Lake Association (CLA) to complete aquatic vegetation sampling in order to create a lakewide, long-term integrated aquatic vegetation management plan. The study area includes all three basins of Crooked Lake, which is located northwest of Angola in Steuben County, Indiana. This plan was created in order to more accurately document the aquatic vegetation community and create a feasible plan for managing nuisance vegetation within the Crooked Lake. The plan is also a prerequisite to eligibility for the Lake and River Enhancement (LARE) program funding to control exotic or nuisance species. Two aquatic vegetation surveys were completed in 2006 in order to document the plant community. The surveys will provide valuable information that will allow for scientifically based recommendations for aquatic plant management. The focus of aquatic plant management will be on the control of exotic invasive species. However, there may be small areas of native vegetation that will require control in high-use areas.

The primary nuisance plant species in the chain of lakes is the exotic species Eurasian watermilfoil. Curlyleaf pondweed was also present at potentially nuisance levels during spring sampling. It is important to initiate management of these species in order to reduce nuisance conditions and stop their spread. In order to successfully manage aquatic vegetation on a public body of water concerns of fishermen, lot owners, biologists, and the general public will have to be addressed. The purpose of this plan is to provide plant management recommendations that will balance the concerns of these interest groups while effectively relieving Crooked Lake of nuisance aquatic plant growth while working towards the goals of the plant management program.

2.0 WATERSHED AND WATERBODY CHARACTERISTICS (Summarized from JFNew & Associates, Inc., 2003 & IDNR, 2001)

Crooked Lake is an approximately 802 acre natural lake that consists of three sections called the first (401 acres), second (217 acres), and third basins (184 acres). The average depth of Crooked Lake is 12.0 feet and the maximum depth is 77 feet. The third basin is by far the most shallow of the three basins (Figure 1). Crooked Lake is classified as Mesotrophic, which means the lake is moderately productive. Secchi measurements taken during plant surveys ranged from 8.0 to 10.5 feet in the first and second basins and from 4.0-5.0 feet in the third basin.

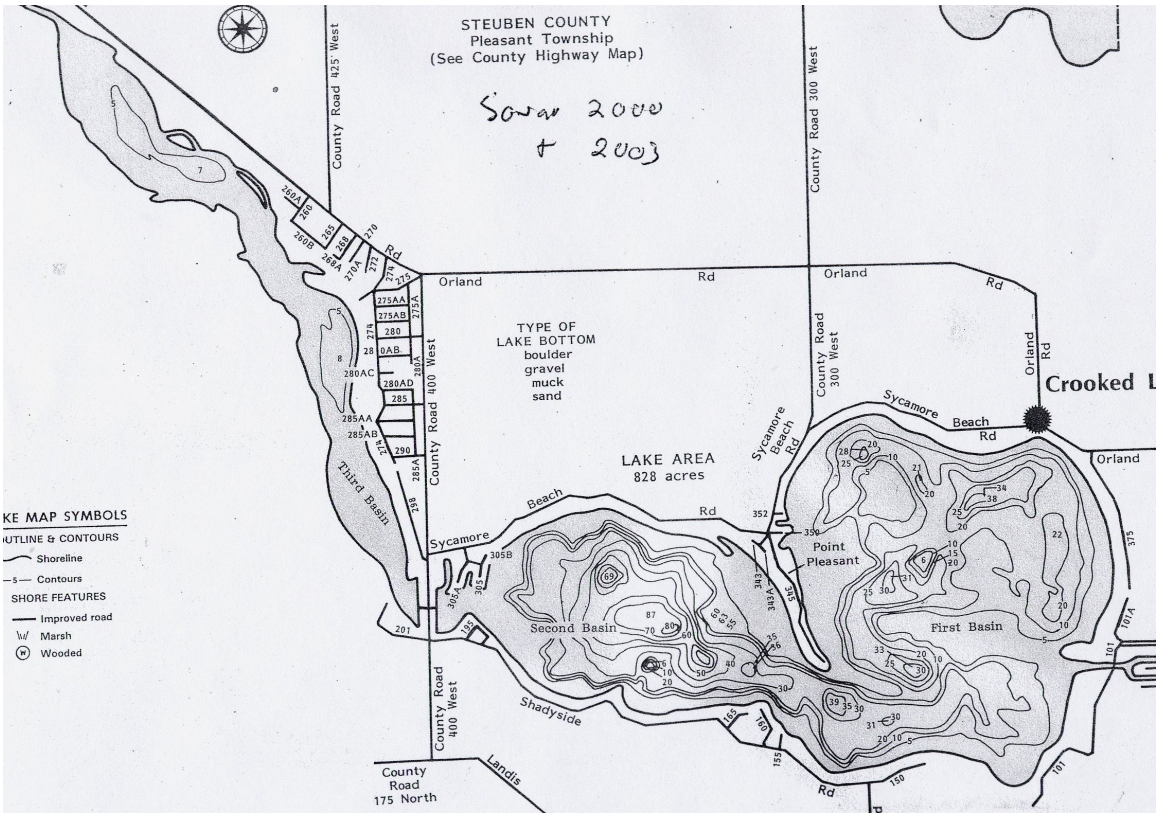

Figure 1. Crooked Lake Bathymetric Map (Bright Spot Maps, 2000)

The Crooked Lake watershed encompasses 7,512 acres in central Steuben County. The watershed is part of the St. Joseph River Basin, which conducts water to Lake Michigan. Carpenter Drain, Palfreyman Drain, and the Loon Lake tributary transport runoff water from the watershed to Crooked Lake. Water drains out of Crooked Lake from the northwest corner of the third basin through a tributary to Lake Gage. Land to the west of the lake exhibits a gently rolling topography while land to the east of the lake is flatter with large wetland expanses draining through Carpenter Drain to the lake. A large portion of the watershed has been converted to agricultural land use. Today, about 54% of the watershed is utilized for agricultural purposes including row crop and pasture. Residential and commercial land use composes 7.6% of the watershed. Forests, wetlands, and open water account for approximately 38% of the total watershed (JFNew, 2003). The Crooked Lake Association, in cooperation with IDNR and JFNew are in the process of initiating improvements on several of the incoming water sources.

3.0 PRESENT WATER BODY USES

Crooked Lake is used for a variety of activities. A public access site and beach are located in the eastern end of the first basin of Crooked Lake at a Steuben County Park. Several private boat ramps are located on all three basins. The entire shoreline of the first and second basin is developed residentially. The eastern shore of the third basin is also residentially developed while the western shore of the third basin remains primarily undeveloped. Fishing, boating, and swimming are popular activities on Crooked Lake. At a recent public meeting, lake users indicated that 94% used the lake for boating and swimming, 67% for fishing, and 40% used the lake for irrigation (survey included 15 individuals, primarily property owners on the Lake).

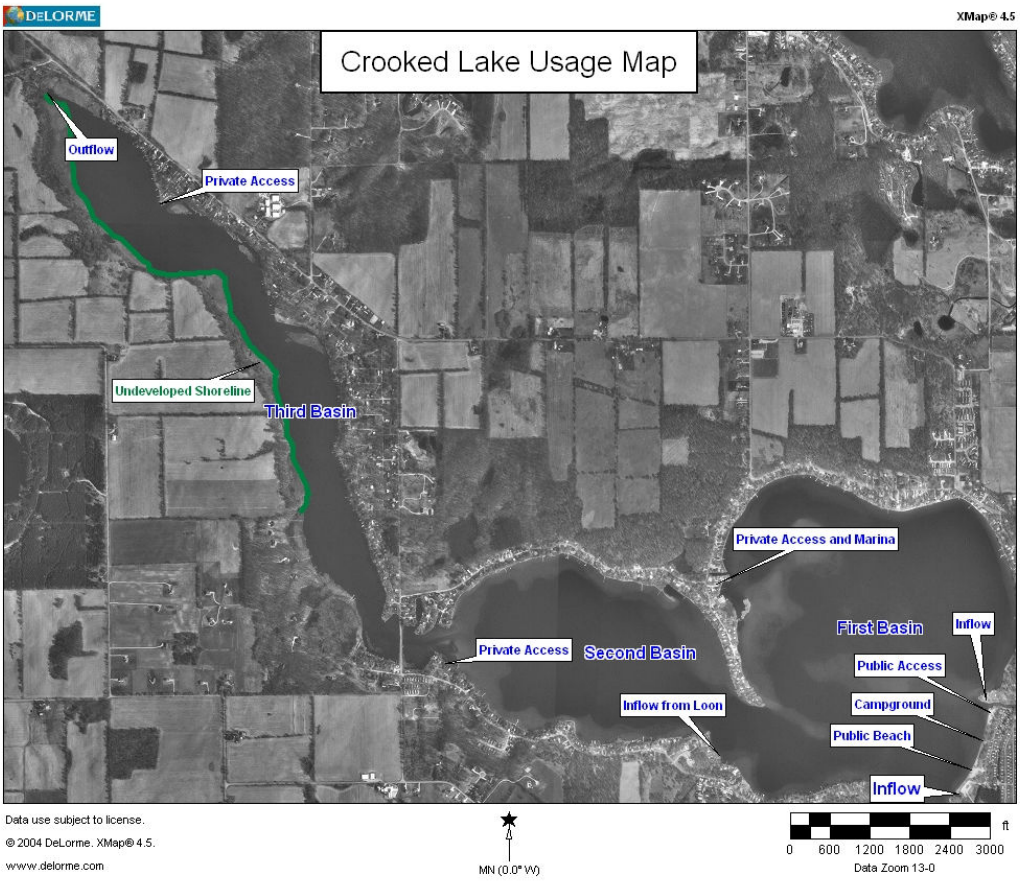

Figure 2. Crooked Lake Usage Map

4.0 FISHERIES

Fisheries studies were conducted by fisheries biologists from the IDNR in 1966, 1972, 1978, 1987, 2001, and 2005. A creel survey was completed on the lake in 2003. The study conducted in 2001, found that Crooked Lake continued to support a good sport fishery dominated by bluegill. The average size of bluegill had increased and a relatively large percentage of the population consisted of eight inch and larger fish. Bass, yellow perch, black crappie, and northern pike also provided additional fishing opportunities (Table 1). It was also noted, that after an absence of several years, walleye stocking was again taking place. The first stocking of 8,000 walleye was completed in September of 2001. This stocking was done to evaluate the effectiveness of stocking large fall fingerlings. The success of the 2001 stocking has led to annual supplemental additions of walleye through 2006.

Table 1. Species and Relative Abundance of Fishes Collected June 25-29, 2001 (IDNR, 2001).

Common Name of Fish	Number	Percent
Bluegill	913	71.9
Largemouth Bass	89	7
Redear Sunfish	56	4.4
Common Carp	42	3.3
Spotted Gar	30	2.4
Yellow Perch	25	2.0
Black Crappie	19	1.5
Yellow Bullhead	16	1.3
Northern Pike	15	1.2
Hybrid Bluegill	13	1.0
Golden Shiner	11	0.9
Smallmouth Bass	8	0.6
Pumpkinseed	7	0.6
Rock Bass	7	0.6
Spotfin Shiner	7	0.6
Bowfin	3	0.2
Brown Bullhead	3	0.2
Longnose Gar	2	0.2
Green Sunfish	1	0.1
Walleye	1	0.1
Warmouth	1	0.1

A creel survey was conducted on Crooked Lake from May 1 through October 31, 2003. The following is a summary of the IDNR 2003 Creel Survey Report. A total of 770 angling parties comprised of 1,445 anglers were interviewed during the survey. The number one species harvested was bluegill (63%) followed by black crappie (29%), largemouth bass (2%), and walleye (2%). Bluegill also dominated the harvest by weight. In addition to the species harvested, anglers caught and released 8,879 largemouth bass, 4,507 walleye, and 85 northern pike. Largemouth bass was the most sought after species and Crooked Lake also exhibited much higher catch rates for this species when compared

to other northern Indiana lakes. Almost 80% of anglers surveyed believed that fishing had improved. The creel survey recommended that the stocking of fall walleye fingerlings continue as long as the state has sufficient funds to support the program. In addition, DFW biologists should continue to work with the lake residents in conducting an efficient yet constructive aquatic vegetation control program (IDNR, 2003).

4.1 Aquatic Vegetation and Fish Management

Aquatic vegetation is an important component in fisheries management. Aquatic vegetation provides cover for adult and juvenile fish, supports aquatic invertebrates that are eaten by fish, and shelters small fish from predators. However, dense vegetation, especially Eurasian watermilfoil, can have negative effects on fish growth. Dr. Mike Maceina of Auburn University found that dense stands of Eurasian watermilfoil on Lake Guntersville proved to be detrimental to bass reproduction due to the survival of too many small bass. This led to below normal growth rates for largemouth bass and lower survival to age 1. Maceina found higher age 1 bass density in areas that contained no plants verses dense Eurasian watermilfoil stands (Maceina, 2001). Bluegill growth rates can also be affected by dense stands of Eurasian watermilfoil. It is well known by fisheries biologists that overabundant dense plant cover gives bluegill an increased ability to avoid predation and increases the survival of small young fish, which can lead to stunted growth.

5.0 PROBLEM STATEMENT

As previously mentioned, aquatic vegetation is an important component of lakes in Indiana. However, as a result of many factors, this vegetation can develop to a nuisance level. Nuisance aquatic vegetation, as used in this paper, describes plant growth that negatively impacts the present uses of the lake including fishing, boating, swimming, aesthetic, and lakefront property values. The primary nuisance species within the Crooked Lake is the exotic species Eurasian watermilfoil. Curlyleaf pondweed is another submersed exotic species that is present in Crooked Lake and has the potential to create nuisance conditions. Purple loosestrife is an invasive exotic emergent species that was also detected during the 2006 sampling. It is unlikely that purple loosestrife will create nuisance conditions for lake users, but this species could have negative impacts on native wetland species in and around Crooked Lake.

5.1 Problems Caused By Eurasian Watermilfoil

Eurasian watermilfoil is an exotic invasive species of submersed vegetation that was likely introduced into our region prior to the 1940's (Figure 3). This species commonly reaches nuisance levels in Indiana Lakes. Once established, growth and physiological characteristics of milfoil enable it to form a surface canopy and develop into immense stands of weedy vegetation, outcompeting most submersed species and displacing the native plant community. These surface mats can severely impair many of the functional aspects of waterbodies such as maintenance of water quality for wildlife habitat and public health, navigation, and recreation. Furthermore, a milfoil-dominated community

can greatly reduce the biodiversity of an aquatic system and negatively impact fish populations (Getsinger et. al., 1997).

Figure 3. Illustration of Eurasian watermilfoil (Illustration provided by Applied Biochemist).

5.2 Problems Caused by Curlyleaf Pondweed

Curlyleaf pondweed is an invasive exotic submersed species that was likely introduced in the early 1900's. It is present in many Indiana natural lakes and manmade impoundments. Curlyleaf pondweed's wavy serrated leaves give it a rather unique appearance (Figure 4). Richardon's pondweed (*Potamogeton richarsonii*) is probably the only species that it can be easily confused with. Curlyleaf pondweed has the tendency to create dense surface mats in the spring and early summer. These mats can interfere with recreation and limit the growth of native species. Another problem associated with this species is caused by its summer die-off that tends to lead to algae blooms. The summer die-off also tends to lessen the impact of this species on lake recreation.

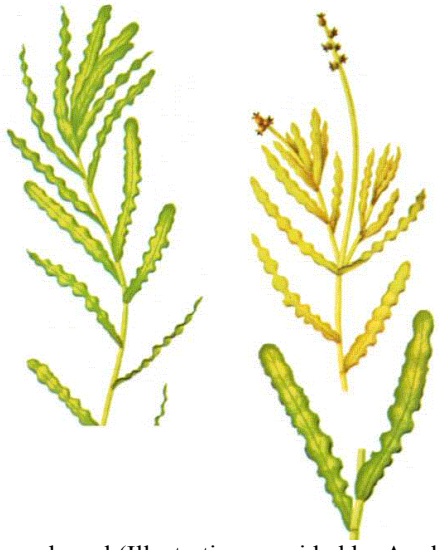

Figure 4. Illustration of curlyleaf pondweed (Illustration provided by Applied Biochemist).

5.3 Problems Caused by Purple Loosestrife

Purple loosestrife is an exotic invasive species of emergent vegetation that has invaded many wetlands and lake margins throughout Indiana (Figure 5). This species was introduced from Eurasia and became established in the estuaries of northeastern North America by the early 1800's. The impact of purple loosestrife on native vegetation has been disastrous, with more than 50% of the biomass of some wetland communities displaced. Impacts on wildlife have not been well studied, but indicate serious reduction in waterfowl and aquatic furbearer productivity (Thompson et. al., 1987).

Figure 5. Illustration of Purple Loosestrife (Illustration provided by Applied Biochemist).

6.0 VEGETATION MANAGEMENT GOALS

An effective aquatic vegetation management plan must include well-defined goals and objectives. Listed below are three goals formulated by LARE program staff and Division of Fish and Wildlife Biologists and approved by the Crooked Lake Association. The objectives and actions used to meet the objectives will be discussed in section 12.0. One must have a better understanding of the plant community before the objectives and actions can be discussed.

Vegetation Management Goals

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and fish and wildlife resources.

7.0 PLANT MANAGEMENT HISTORY

Herbicides have been the primary nuisance plant control method used on Crooked Lake. Aquatic Management Inc. has treated Crooked Lake since 1994. Eurasian watermilfoil and curlyleaf pondweed have been the primary targeted species. Diquat, Hydrothol 191, Aquathol K, Nautique, and Komeen have been used for the majority of contact herbicide treatments. The third basin has received the majority of treatment, including two whole basin fluridone treatments in 2000 and 2003. Table 2 summarizes the treatments since 1994 (data collected from IDNR permit applications). Total acres of treatment have ranged from a low of 9.5 acres in 2004 after the second fluridone treatment, to a high of 169.3 acres in 2003.

Table 2. Crooked Lake Treatment History.

Year	Offshore Treatment Acres	Shoreline Treatment Acres	Total Acres	Method of Control
1994	86.0	10.0	96.0	
1995	86.0	10.0	96.0	
1996	86.0	10.0	96.0	
1997	?	?	105.0*	
1998	62.0	10.0	72.0	
1999	30.0	10.0	40.0	
2000	165.0		165.0	Sonar (3rd basin)
2001		10.0	10.0	
2002		10.0	10.0	
2003	163.7	6.0	169.3	Sonar (3rd basin)
2004		9.5	9.5	
2005	42.9	9.7	52.6	
2006	91.0	10.1	101.1	

*Proposed treatment. Need for control was scaled back to spot treatment due to unexplained die-off of Eurasian watermilfoil

The most recent treatment was completed in the spring of 2006 to several nuisance plant areas on all three basins. This treatment totaled approximately 101.1 acres. Figure 6 illustrates the approximate location of the 2006 treatment. This treatment was completed using a combination of Reward, Aquathol K, Nautique, and copper sulfate. According to the CLA, the treatment was successful at reducing nuisance conditions.

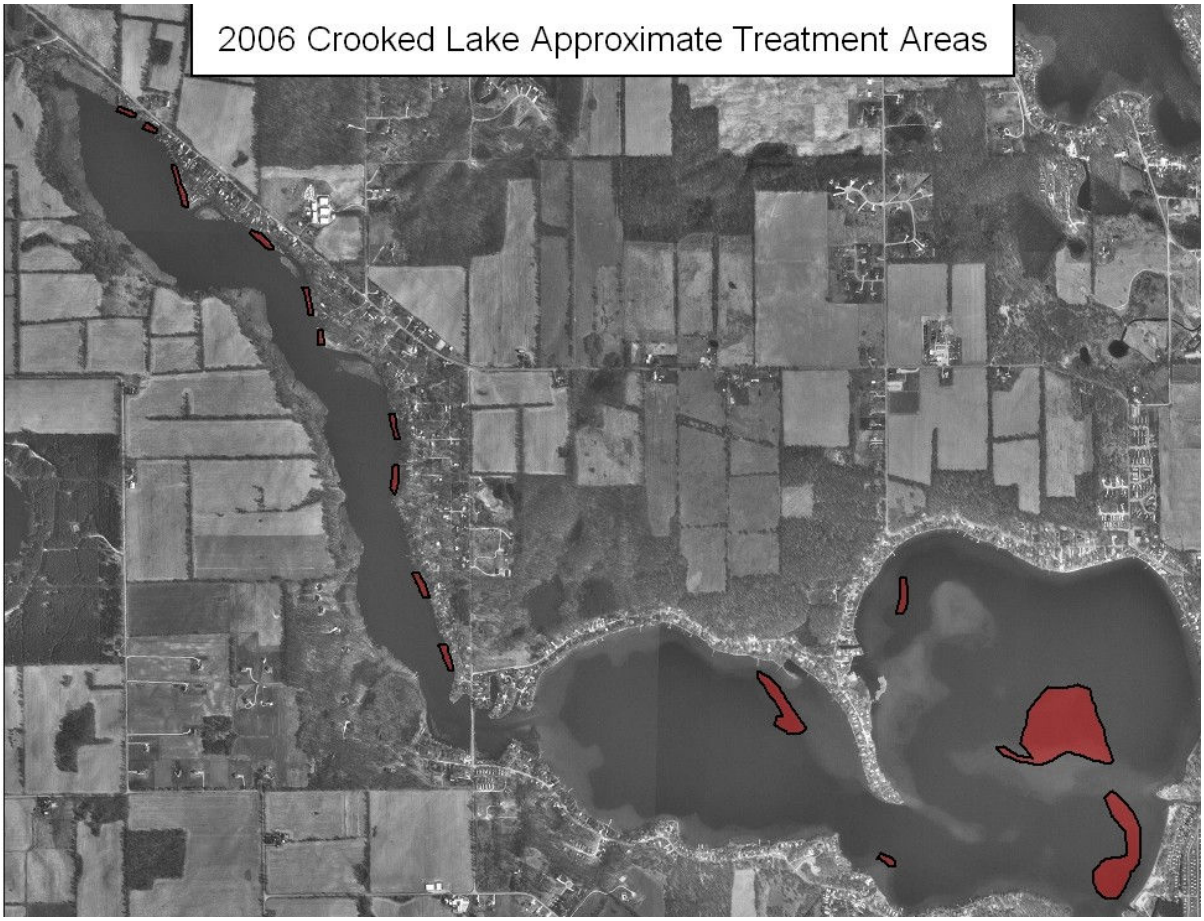

Figure 6. Crooked Lake, 2006 approximate treatment areas.

8.0 AQUATIC PLANT COMMUNITY CHARACTERIZATION

Aquatic vegetation sampling must be completed in order to create an effective aquatic vegetation management plan. Sampling provides valuable data that allows managers to accomplish several tasks: locate areas of nuisance and beneficial vegetation; monitor changes in density, abundance, and location of native and exotic species; monitor and react to changes in the overall plant community; monitor the effectiveness of management techniques; and compare the Crooked Lake plant community to other populations. IDNR has completed plant surveys prior to fisheries studies in 1966, 1972, 1978, 1987, 2001, and 2005. IDNR surveys from 1966-2001 consisted primarily of visual reconnaissance surveys. The IDNR survey in 2005 used the Tier II method that is described below. Two surveys were conducted by Aquatic Control in 2006 to obtain an accurate representation of plant species that occur during different times of the year. The surveys focused primarily on submersed, floating, rooted floating, and emergent vegetation that occurred within the actual lake. Wetlands and inaccessible shoreline margin areas were not surveyed. The methods and results of these surveys will be discussed below.

8.1 Methods

8.1.1 Tier I Methods

The Tier I survey is also known as a reconnaissance survey. This method was developed to serve as a qualitative surveying mechanism for aquatic plants. This survey method serves to meet the following objectives:

1. to provide a distribution map of the aquatic plant species within a waterbody
2. to document gross changes in the extent of a particular plant bed or the relative abundance of a species within a waterbody

This survey strategy was augmented with the Tier II survey to gain more quantitative data if desired. The major advantage of this type of survey is the relatively small amount of time required to complete a survey. Prior to beginning a Tier I survey, information is gathered on the lake being surveyed. This information includes lake size, maximum depth, historical species lists, and historical Secchi depth data. The entire littoral zone (area of the lake which can grow vegetation) of the lake is briefly examined during the survey. A counter clock-wise path is taken around the littoral zone of the lake. While the boat is slowly zigzagging, aquatic plant abundances are recorded based on visual observation. Abundance rating are based on 1-4 increments with 1 being less than 2% and 4 representing greater than 61% abundance. Rake throws are made if there is dense surface cover or if there is difficulty in visually assessing plant species. The littoral zone is broken up into individual plant beds (plant beds are defined as contiguous consistent plant communities). Vegetation cover ratings, substrate types, and canopy coverage are also determined during the survey (IDNR, 2006).

8.1.2 Tier II Methods

The Tier II survey helps meet the following objectives:

1. to document the distribution and abundance of submersed and floating-leaved aquatic vegetation

2. to compare present distribution and abundance with past distribution and abundance within select areas

The number and depth of sampling sites are selected based upon lake size and classification as per DNR Tier II sampling protocol. One hundred sites were sampled on Crooked Lake. Of the one hundred site, 33 sample sites were randomly selected from 0-5 feet, 31 sites were from 6-10 feet, 26 sites from 11-15 feet, and 10 sites were from 16-20 feet (next season no sites should be deeper than 17.0 feet since this was the maximum depth plants were detected). Once a site was reached the boat was slowed to a stop and the coordinates were recorded on a hand-held GPS unit and later downloaded into a mapping program. A depth measurement was taken by dropping a two-headed standard sampling rake that was attached to a rope marked off in 1-foot increments (Figure 7). An additional ten feet of rope was released and the boat was reversed at minimum operating speed for a distance of ten feet. Once the rake is retrieved the overall plant abundance on the rake is scored with either a 0 (no plants retrieved), 1 (1-20% of rake teeth filled), 3 (21-99% of rake teeth filled), or 5 (100% of rake teeth filled) and then individual species are placed back on the rake and scored separately.

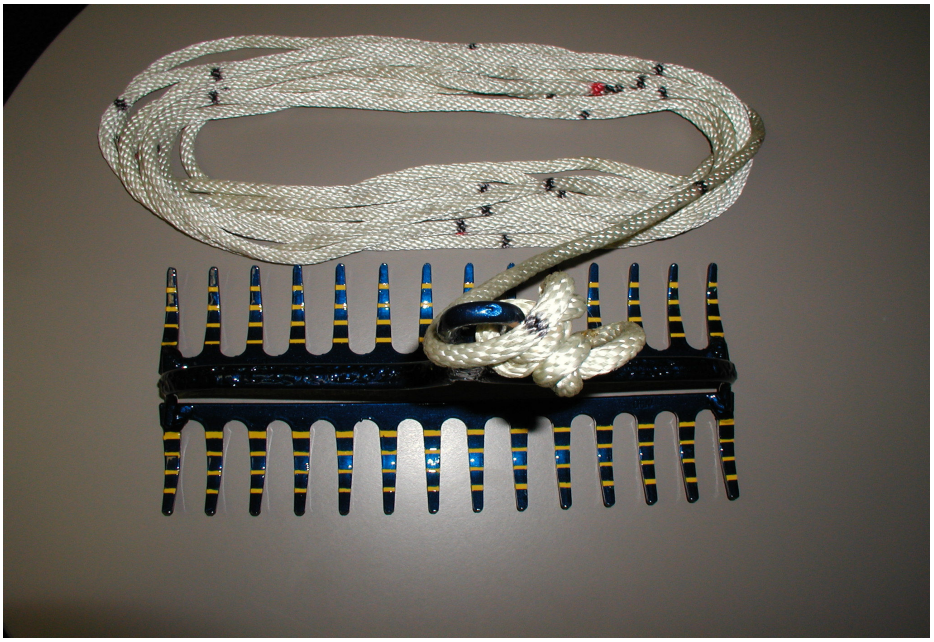

Figure 7. Sampling Rake

The data is used to calculate different lake characteristics and community and species metrics. The different characteristics and metrics calculated from the Tier II method are defined below:

Littoral depth: Maximum depth that aquatic vegetation is present.
Total sites: Total number of sites sampled.
Littoral sites: Number of sites within the littoral depth.
Secchi depth: Measurement of the transparency of water.
Species richness: count of all submersed plant species collected.

Native species richness: count of all native submersed plant species collected.
Maximum number of species per site: highest number of species collected at any site.
Mean number of species per site: The average number of all species collected per littoral site.
Mean number of native species per site: The average number of native species per site.
Species diversity index: This is a modified Simpson's diversity index which is a measure that provides a means of comparing plant community structure and stability over time.
Frequency of occurrence: Measurement of the proportion of sites where each species is present.
Relative frequency of occurrence: Measures how the plants occur throughout the lake in relation to each other.
Dominance index: Combines the frequency of occurrence and relative density into a dominance value that characterizes how dominant a species is within the macrophyte community (IDNR, 2006).

8.2 Results

8.2.1 Crooked Lake Plant Surveys Prior to 2006

IDNR has completed plant sampling prior to fisheries surveys in 1966, 1972, 1978, 1987, 2001, and 2005. Surveys from 1966-2001 consisted of visual assessments of the plant community. The 2005 survey was completed using a version of the Tier II sampling method.

The 1966 survey found soft rush (*Juncus effuses*) to be the most abundant emergent species. Abundant emergent vegetation was present in the third basin. Watershield (*Brasenia schreberi*), water lily (*Nymphaea tuberosa*), and spatterdock (*Nuphar variegetum*) were "choking" the channel connecting the second and third basin. Illinois pondweed (*Potamogeton illinoensis*) was considered to be the most abundant submersed species in the first and second basin, but was not at nuisance levels. Bladderwort (*Utricularia vulgaris*), Illinois pondweed, and American pondweed (*Potamogeton nodosus*) were abundant in third basin. Watermilfoil (*Myriophyllum spp.)* was observed in a narrow band in the first basin (IDNR, 1966).

The 1972 survey found milfoil (species not defined) to be the dominant plant in the first basin. It was estimated that 20% of the first basin was covered. Milfoil and Illinois pondweed were dominant in the second basin while milfoil was dominant in the third basin. It was recommended that control be limited to shoreline patches (IDNR, 1972).

There is not a lot of plant abundance data from the 1978 survey. Milfoil and curlyleaf pondweed were observed and it was mentioned that a plant control program had been

initiated that year. The survey suggested to continue the plant control and found no indication of affects on the fishery from the 1978 treatments (IDNR, 1978).

There was also very little abundance data from the 1987 survey. Milfoil and curlyleaf pondweed were observed, but it is not clear what species of milfoil was observed or how abundant either of these species were. It is mentioned that water quality was generally good and that vegetation in the first basin was abundant (IDNR, 1987).

The 2001 survey report discussed a milfoil die-off that occurred in 1997 and concludes that there was no definitive reason for the kill. A number of investigations were conducted to find the reason for the die-off of Eurasian watermilfoil. These investigations included searching for biological reasons such as weevils, analyzing water and soil samples for herbicides, and sending plant samples to the U.S. Army Core of Engineers plant research lab for testing. The further investigations did not conclusively explain the reason for the die-off of Eurasian watermilfoil. One theory is that sediments suspended from boating activities may have reduced the photosynthetic ability of the plant. A transect surveying method was used during the 2001 survey (exact methods are not discussed). Eurasian watermilfoil was identified to species and still appeared to be one of the most abundant species in Crooked Lake (IDNR, 2001).

A Tier II survey was completed by IDNR on September 1, 2005 (Table 3). A total of 135 sites were surveyed of which 134 were within the littoral zone. Plants were growing to a maximum depth of 16.0 feet. The Secchi depth was determined to be 9.0 feet. Eighty-six sites contained vegetation and a total of 16 species were collected of which 14 were native. Eurasian watermilfoil ranked highest in frequency of occurrence and dominance followed by variable pondweed (*Potamogeton gramineus*), sago pondweed (*Potamogeton pectinatus*), chara (*Chara spp.),* and coontail (*Ceratophylum spp*.).

Table 3. Occurrence and Abundance of Submersed Aquatic Plants, September 1, 2005 (IDNR, 2005).

Occurrence and Abundance of Submersed Aquatic Plants								
Date:	9/1/05		Littoral sites with plants:		86	Species diversity:		0.86
Littoral depth (ft):	16.0		Number of species:		16	Native diversity:		0.84
Littoral sites:	134		Maximum species/site:		6	Rake diversity:		0.84
Total sites:	135		Mean number species/site:		1.31	Native rake diversity:		0.83
Secchi:	9.0		Mean native species/site:		0.92	*Mean rake score:		0.68
Common Name		**Site frequency**		**Relative density**		**Mean density**		**Dominance**
Bladderwort		2.2		0.02		1.00		0.4
Chara		13.4		0.27		2.00		5.4
Clasping-leaf Pondweed		3.0		0.03		1.00		0.6
Coontail		11.2		0.17		1.53		3.4
Curly-leaf Pondweed		6.7		0.07		1.00		1.3
Eel Grass		2.2		0.02		1.00		0.4
Eurasian Watermilfoil		32.1		0.57		1.77		11.3
Flat-stemmed Pondweed		1.5		0.01		1.00		0.3
Illinois Pondweed		1.5		0.01		1.00		0.3
Variable Pondweed		23.1		0.33		1.42		6.6
Sago Pondweed		19.4		0.25		1.27		4.9
Slender naiad		7.5		0.07		1.00		1.5
Water Bullrush		1.5		0.02		1.50		0.4
Water Stargrass		3.0		0.04		1.25		0.7
Spiny Naiad		0.7		0.01		2.00		0.3
Elodea sp		1.5		0.01		1.00		0.3
Other Observed Plants:								
Arrow Arum, Cattail, Hardstem Bulrush, Pickerelweed, Spatterdock, Softstem Bulrush, White Waterlily,								
Yellow Waterlily								

Aquatic Control completed surveys on June 14 and August 23, 2006. A Tier I survey was completed on June 14 and August 23. A Tier II survey was also completed on August 23. Table 4 is a list of the common and scientific names of all of the species sampled during those surveys.

Table 4. Common and Scientific Names of Species Sampled from Crooked Lake in 2006.

Scientific Name	*Common Name*
Brasenia schreberi	watershield
Cephalanthus occidentalis	button bush
Ceratophyllum demersum	common coontail
Chara spp.	Chara
Elodea canadensis	American elodea
Elodea nuttali	western elodea
Iris pseudacorus	yellow iris
Iris versicolor	blue flag iris
Justicia americana	water willow
Lemna minor	common duckweed
Lythrum salicaria	purple loosesrtife
Myriophyllum spicatum	Eurasian watermilfoil
Najas flexilis	slender naiad
Najas minor	brittle naiad
Nuphar variegetum	spatterdock
Nymphaea tuberosa	white water lily
Pontederia cordata	pickerel weed
Potamogeton amplifoilus	largeleaf pondweed
Potamogeton crispus	curlyleaf pondweed
Potamogeton foliosus	leafy pondweed
Potamogeton gramineus	variable pondweed
Potamogeton illinoensis	Illinois pondweed
Potamogeton pectinatus	sago pondweed
Potamogeton pusillus	small pondweed
Potamogeton richardsonii	Richardson's pondweed
Potamogeton zosteriformis	flatstem pondweed
Ranunculus flabellaris	yellow water buttercup
Scirpus validus	soft-stem bulrush
Spirodela polyrhiza	giant duckweed
Typha latifolia	common cattail
Utricularia vulgaris	common bladderwort
Vallisneria americana	eel grass
Wolffia columbiana	watermeal
Zannichellia palustris	horned pondweed
Zosterella dubia	water stargrass

8.2.2 2006 Spring Survey

On June 14, 2006, Aquatic Control completed a Tier I survey on Crooked Lake. A Secchi measurement was taken and found to be 8.0 feet. The Tier I survey revealed 32 distinct plant beds within Crooked Lake totaling 479.9 acres. (Table 5 & Figure 8 & 9). Vegetation was present to a maximum depth of 13 feet. Twenty-eight different species were observed.

Table 5. Crooked Lake Tier I Survey Results, June 14, 2006.

Lake: Crooked		Number of plant beds: 32						Littoral zone max depth: 13																								
Date: June 14, 2006		Number of species: 28																														
Secchi: 8.0		Littoral zone size: 479.9																														
Plant Bed I.D.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Plant Bed Size (acres)	**2.8**	**0.1**	**196.6**	**0.3**	**30.1**	**2.2**	**2.8**	**0.2**	**40.3**	**3.0**	**0.9**	**0.6**	**19.9**	**2.7**	**0.9**	**6.4**	**3.3**	**0.5**	**3.8**	**2.9**	**1.2**	**6.9**	**92.4**	**4.6**	**1.1**	**3.8**	**7.7**	**0.2**	**10.8**	**20.0**	**6.5**	**4.6**
Eurasian watermilfoil	3	1	1	3	4	4	4	-	2	1	4	4	4	-	3	2	2	4	3	3	4	4	2	4	2	4	4	2	4	3	4	4
American elodea	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
common coontail	2	-	-	1	1	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	-	-	1	-
curlyleaf pondweed	2	1	1	3	2	2	2	-	3	-	2	1	1	-	2	-	2	-	3	1	2	2	2	3	-	2	2	1	2	3	3	2
watermeal	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
flatstem pondweed	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-
sago pondweed	1	-	-	-	1	1	1	-	-	-	-	1	1	-	1	2	1	-	-	-	-	-	1	-	-	-	-	-	1	1	1	-
Richardson's pondweed	1	-	1	-	1	-	-	1	1	-	-	-	1	1	-	2	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
spatterdock	-	3	-	-	-	-	-	2	-	2	-	-	-	2	-	1	1	3	-	-	-	-	1	-	-	-	-	1	-	2	-	-
white water lily	-	1	1	-	1	1	1	-	1	1	-	-	-	2	-	-	3	2	-	4	-	-	1	-	3	-	1	4	1	3	1	-
water willow	-	2	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
purple loosestrife	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
common cattail	-	2	-	-	-	-	-	3	-	2	-	-	-	2	-	-	2	-	-	-	-	-	-	-	3	-	-	-	-	2	-	-
soft-stemmed bulrush	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
Chara	-	-	1	-	-	-	-	1	-	2	-	-	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
eel grass	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
small pondweed	-	-	-	1	1	1	-	-	1	1	-	-	1	-	1	1	1	1	1	-	1	1	1	-	-	1	-	-	-	1	-	1
slender naiad	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
horned pondweed	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
watershield	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
largeleaf pondweed	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	2	1	1	-	1	1	3	2	1	-	3	1	-	-	1	-	3
Illinois pondweed	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pickeral weed	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
button bush	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-
white waterbuttercup	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
yellow flag iris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
blue flag iris	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
duckweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-

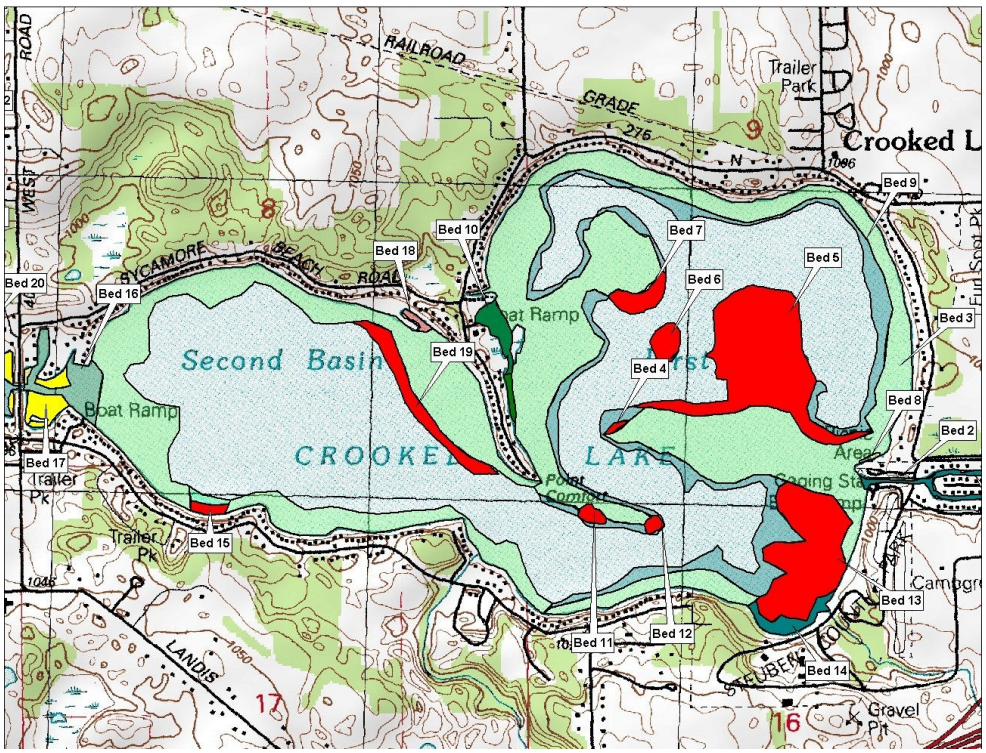

Figure 8. Tier I Plant Beds, Crooked Lake (first and second basin), June 14, 2006

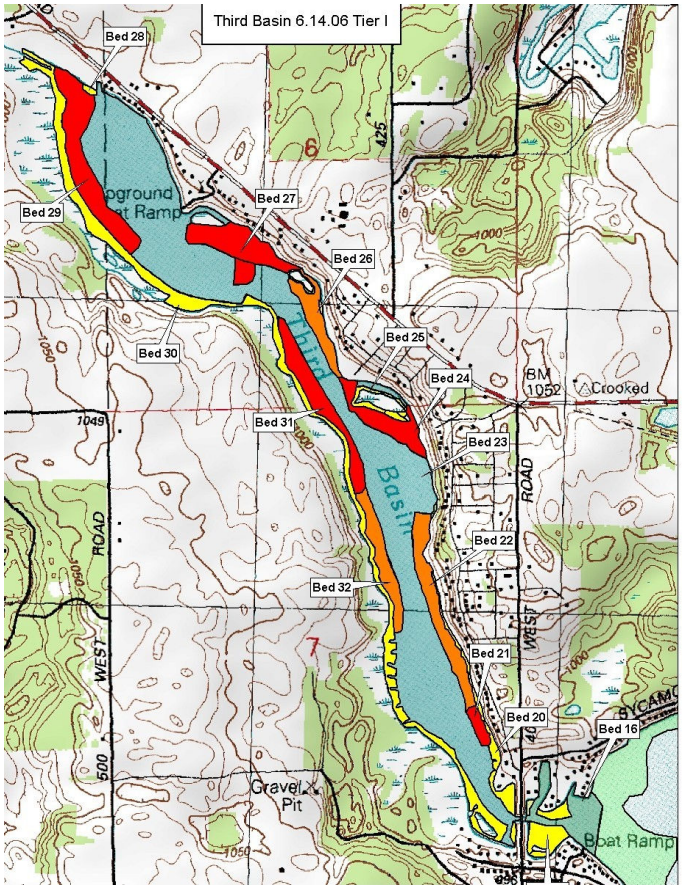

Figure 9. Tier I plant beds, Crooked Lake (third basin), June 14, 2006

Eurasian watermilfoil was the most abundant species present during the spring survey. Milfoil had reached the surface in many areas of Crooked Lake. Milfoil was present at an abundance rating of 3 or higher in plant beds 1, 4-7, 11-13, 15, 18-22, 24, 26, 27, and 29-32 (red areas in Figures 8 & 9). These beds totaled 133.8 acres. Dense milfoil beds were found in several large areas of the first basin and a large majority of the third basin. There was very little Eurasian watermilfoil present in the second basin. Curlyleaf pondweed was also abundant in some of the same beds as Eurasian watermilfoil.

All three basins contained plant beds that are likely beneficial to the overall quality of Crooked Lake. Plant bed 10 was located on the western side of the first basin and was by far the most diverse bed of submersed plants. Plant bed 30 included the shallow margin area of the third basin. This bed contained a variety of important rooted floating plant species along with emergent wetland species. Steps should be taken to protect these plant beds.

8.2.3 2006 Summer Survey

On August 23, 2006, a second round of sampling was completed. Sampling consisted of a Tier I and Tier II surveys.

Summer Tier I survey

The Tier I survey was completed prior to the Tier II survey. A Secchi measurement was taken prior to the survey and found to be 10.5 feet. The Tier I survey revealed 23 distinct plant beds containing twenty-eight different species totaling 490.8 acres. (Table 6 & Figure 10 & 11). Vegetation was present to a maximum depth of 16 feet.

Table 6. Crooked Lake Tier I Survey Results, August 23, 2006.

Lake Name: Crooked	Number of plant beds: 23							Littoral zone max depth: 16.0'														
Date: 8/23/06	Number of species: 28																					
Secchi: 10.5	Littoral zone size: 490.8																					

Plant Bed I.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Plant Bed Size (acres)	3.3	202.4	35.8	24.4	2.5	2.2	3.1	8.2	0.9	6.5	4.1	4.1	10.1	6.5	2.2	80.9	4.0	42.5	20.9	1.3	3.5	3.1	18.3
spatterdock	2	-	-	-	-	-	2	-	3	-	1	4	-	-	-	-	-	-	2	-	-	2	-
white water lily	1	1	-	-	-	1	2	-	2	1	3	-	-	-	3	1	-	-	4	-	-	2	-
purple loosestrife	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
water willow	1	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
common cattail	1	-	-	-	-	-	2	-	-	-	2	-	-	2	3	-	-	-	2	-	-	2	-
watermeal	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
common duckweed	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Eurasian watermilfoil	2	1	4	1	4	4	1	4	2	1	-	1	4	2	-	2	1	4	1	4	1	1	4
slender naiad	2	-	1	3	-	-	2	1	-	-	-	-	-	-	-	2	-	2	-	1	3	1	2
Richardson's pondweed	2	1	-	1	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1	-
Illinois pondweed	1	1	-	-	-	-	-	-	-	1	-	-	1	1	-	1	1	1	-	-	-	-	-
Chara	-	1	1	2	1	-	2	-	1	2	1	-	1	-	-	2	3	2	1	1	2	-	-
eel grass	-	1	-	-	-	-	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-
sago pondweed	-	1	1	1	1	1	-	-	-	2	1	-	1	2	-	1	-	-	-	-	-	-	-
common coontail	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Elodea nutallii	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pickeral weed	-	-	-	-	-	-	2	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-
watershield	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
largeleaf pondweed	-	-	-	-	-	-	-	1	1	2	-	1	2	1	-	1	2	1	1	-	-	-	-
small pondweed	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
blueflag iris	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
variable pondweed	-	-	-	-	-	-	-	-	-	1	-	-	1	1	-	1	2	1	-	-	1	-	-
water stargrass	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	1
soft stem bulrush	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-
common bladderwort	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-
brittle naiad	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
leafy pondweed	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Amercan elodea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1

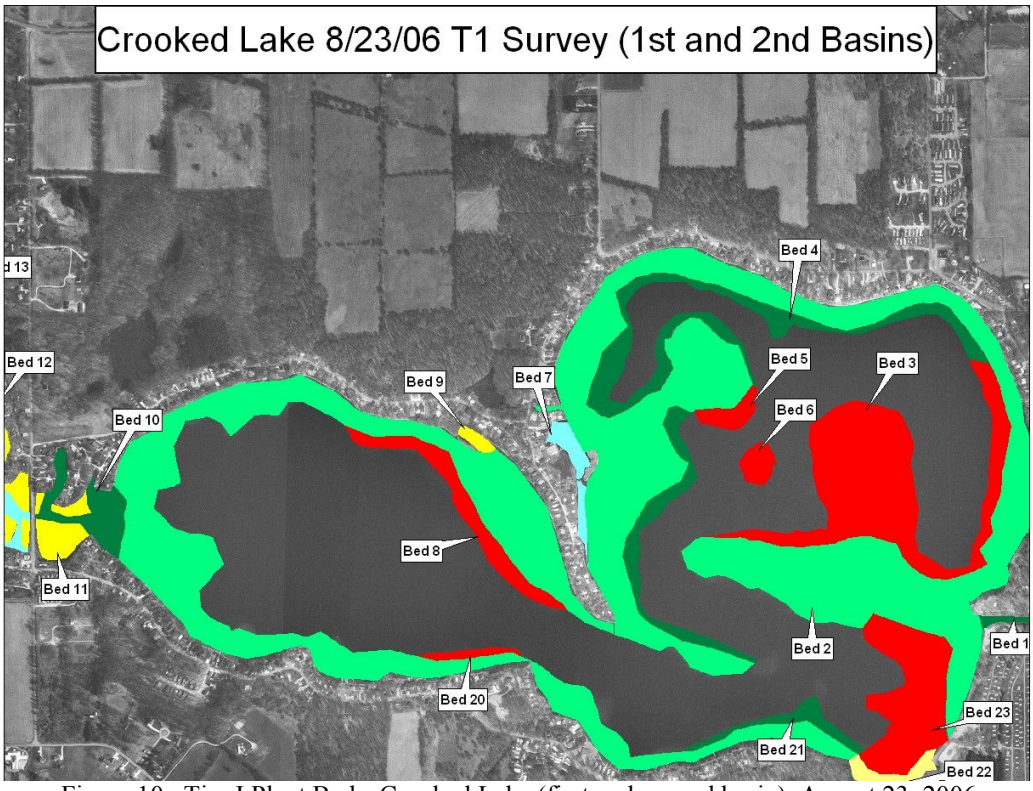

Figure 10. Tier I Plant Beds, Crooked Lake (first and second basin), August 23, 2006

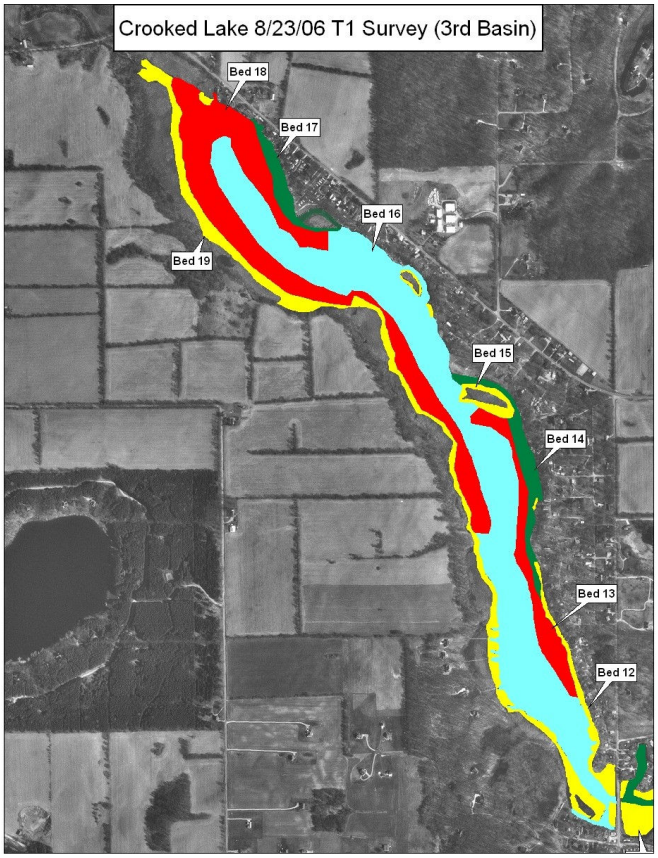

Figure 11. Tier I plant beds, Crooked Lake (third basin), August 23, 2006

Once again, Eurasian watermilfoil was the most abundant species. However, milfoil was no longer topped out across the surface of the lake. It appeared that either treatments or boat traffic had removed the surface canopy in many areas. Milfoil was present in all beds except 11 and 15. It had an abundance rating of 3 or higher in plant beds 3, 5, 6, 8, 13, 18, 20, and 23 (red areas in Figures 10 & 11). These beds totaled 120.9 acres. Dense milfoil beds were still present in the first and third basin. Milfoil was dense in plant bed 8 and 20, which was located in the second basin where there was little milfoil in the spring survey. Small amounts of purple loosestrife were observed in beds 1 and 11.

Summer Tier II survey

Tier II sampling took place on August 23, 2006 immediately following the Tier I sampling. Plants were present to a maximum depth of 17.0 feet. One hundred sites were randomly selected within the littoral zone. Results of the sampling are listed in Table 6. Overall vegetation density and abundance is illustrated in Figure 12. A total of 19 species were collected of which 17 of the species were natives. The maximum number of species collected at a site was 7 and the mean species collected per site was 1.88 while the mean number of native species collected per site was 1.27.

Table 7. Occurrence and abundance of submersed aquatic plants in Crooked Lake, August 23, 2006.

Occurrence and abundance of submersed aquatic plants in Crooked Lake								
County: Steuben		Sites with plants: 78				Mean species/site: 1.88		
Date: 8/23/2006		Sites with native plants: 63				Standard error (ms/s): 0.15		
Secchi (ft): 10.5		Number of species: 19				Mean native species/site: 1.27		
Maximum plant depth (ft): 17		Number of native species: 17				Standard error (mns/s): 0.12		
Trophic status Mesotrophic		Maximum species/site: 7				Species diversity: 0.82		
Total sites: 100						Native species diversity: 0.83		
All depths (0 to 20 ft)	**Frequency of**	**Rake score frequency per species**					**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**			
Eurasian watermilfoil	60.0	40.0	15.0	8.0	37.0		31.2	
slender naiad	40.0	60.0	11.0	3.0	26.0		17.6	
Chara	29.0	71.0	7.0	4.0	18.0		12.6	
common coontail	10.0	90.0	1.0	1.0	8.0		3.2	
variable pondweed	10.0	90.0	3.0	1.0	6.0		2.0	
largeleaf pondweed	8.0	92.0	2.0	1.0	5.0		2.0	
sago pondweed	5.0	95.0	2.0	0.0	3.0		1.0	
Illinois pondweed	5.0	95.0	1.0	0.0	4.0		1.0	
common bladderwort	4.0	96.0	2.0	1.0	1.0		0.8	
brittle naiad	3.0	97.0	0.0	0.0	3.0		1.0	
leafy pondweed	3.0	97.0	1.0	1.0	1.0		0.6	
water stargrass	3.0	97.0	0.0	0.0	3.0		0.6	
variable watermilfoil	2.0	98.0	1.0	0.0	1.0		0.4	
American elodea	1.0	99.0	0.0	0.0	1.0		0.2	
small pondweed	1.0	99.0	1.0	0.0	0.0		0.2	
Richardson's pondweed	1.0	99.0	0.0	0.0	1.0		0.6	
western waterweed	1.0	99.0	1.0	0.0	0.0		0.2	
curlyleaf pondweed	1.0	99.0	0.0	0.0	1.0		0.2	
eel grass	1.0	99.0	0.0	0.0	1.0		0.2	
Depth: 0 to 5 ft	**Frequency of**	**Rake score frequency per species**					**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**			
Eurasian watermilfoil	64.7	35.3	11.8	14.7	38.2		32.9	
Chara	41.2	58.8	5.9	8.8	26.5		17.6	
slender naiad	29.4	70.6	11.8	5.9	11.8		9.4	
variable pondweed	20.6	79.4	2.9	2.9	14.7		4.1	
large leaf pondweed	17.6	82.4	5.9	0.0	11.8		4.7	
coontail	11.8	88.2	2.9	2.9	5.9		3.5	
common bladderwort	11.8	88.2	5.9	2.9	2.9		2.4	
sago pondweed	5.9	94.1	0.0	0.0	5.9		1.2	
variable watermilfoil	5.9	94.1	2.9	0.0	2.9		1.2	
Illinois pondweed	5.9	94.1	0.0	0.0	5.9		1.2	
American elodea	2.9	97.1	0.0	0.0	2.9		0.6	
small pondweed	2.9	97.1	2.9	0.0	0.0		0.6	
leafy pondweed	2.9	97.1	0.0	2.9	0.0		0.6	
Richardson's pondweed	2.9	97.1	0.0	0.0	2.9		1.8	
water stargrass	2.9	97.1	0.0	0.0	2.9		0.6	
eel grass	2.9	97.1	0.0	0.0	2.9		0.6	
Depth: 5 to 10 ft	**Frequency of**	**Rake score frequency per species**					**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**			
Eurasian watermilfoil	70.0	30.0	16.7	6.7	46.7		31.3	
slender naiad	63.3	36.7	16.7	3.3	43.3		35.3	
Chara spp.	30.0	70.0	3.3	3.3	23.3		17.3	
variable pondweed	10.0	90.0	6.7	0.0	3.3		2.0	
Illinois pondweed	10.0	90.0	3.3	0.0	6.7		2.0	
coontail	6.7	93.3	0.0	0.0	6.7		2.7	
brittle naiad	6.7	93.3	0.0	0.0	6.7		2.7	
sago pondweed	6.7	93.3	3.3	0.0	3.3		1.3	
largeleaf pondweed	6.7	93.3	0.0	3.3	3.3		1.3	
leafy pondweed	3.3	96.7	0.0	0.0	3.3		0.7	
western waterweed	3.3	96.7	3.3	0.0	0.0		0.7	
water stargrass	3.3	96.7	0.0	0.0	3.3		0.7	
curlyleaf pondweed	3.3	96.7	0.0	0.0	3.3		0.7	
Depth: 10 to 15 ft	**Frequency of**	**Rake score frequency per species**					**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**			
Eurasian watermilfoil	53.8	46.2	11.5	3.8	38.5		38.5	
slender naiad	42.3	57.7	7.7	0.0	34.6		14.6	
coontail	15.4	84.6	0.0	0.0	15.4		4.6	
Chara	15.4	84.6	7.7	0.0	7.7		3.1	
brittle naiad	3.8	96.2	0.0	0.0	3.8		0.8	
sago pondweed	3.8	96.2	3.8	0.0	0.0		0.8	
water stargrass	3.8	96.2	0.0	0.0	3.8		0.8	
Depth: 15 to 20 ft	**Frequency of**	**Rake score frequency per species**					**Plant Dominance**	
Species	**Occurrence**	**0**	**1**	**3**	**5**			
Chara	20.0	80.0	20.0	0.0	0.0		6.0	
Eurasian watermilfoil	30.0	70.0	30.0	0.0	0.0		6.0	
leafy pondweed	10.0	90.0	10.0	0.0	0.0		2.0	

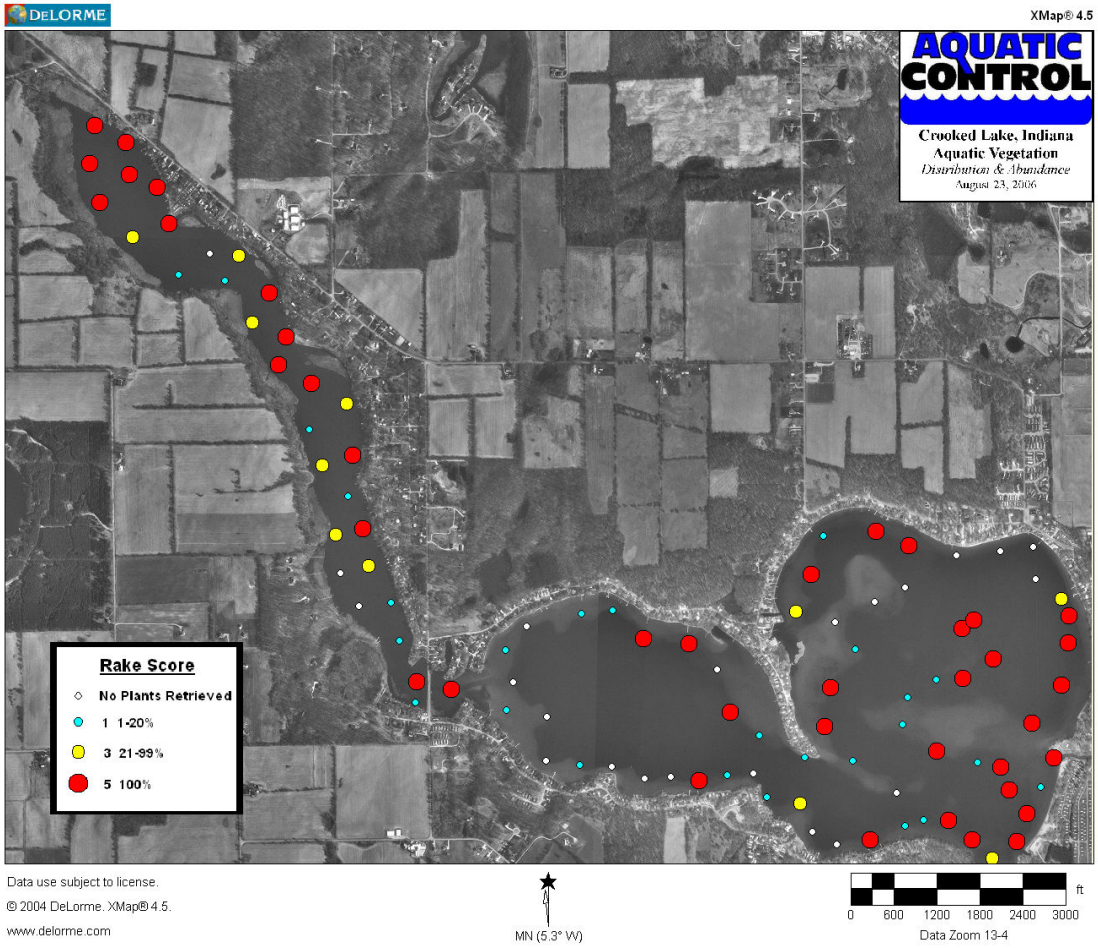

Figure 12. Crooked Lake, aquatic vegetation distribution and abundance, August 23, 2006.

Eurasian watermilfoil and curlyleaf pondweed were the only exotic species collected. Eurasian watermilfoil was present at the highest percentage of sample sites (60.0%) and also had the highest dominance rating (31.2). Location and density of Eurasian watermilfol is illustrated in Figure 13 (in species location and density figures, plant location is illustrated by a color coded dot, the color and size of the dot represents the density of the species and sample sites without that species are illustrated by smaller white diamond). Slender naiad (*Najas flexilis*) ranked second in frequency of occurrence and dominanace (Figure 14). Curlyleaf pondweed was only collected at a single site in the third basin (Figure 15). Despite the presence of two invasive exotic species and the dominance of Eurasian watermilfoil, there was still a good diversity of beneficial pondweeds and other native submersed species.

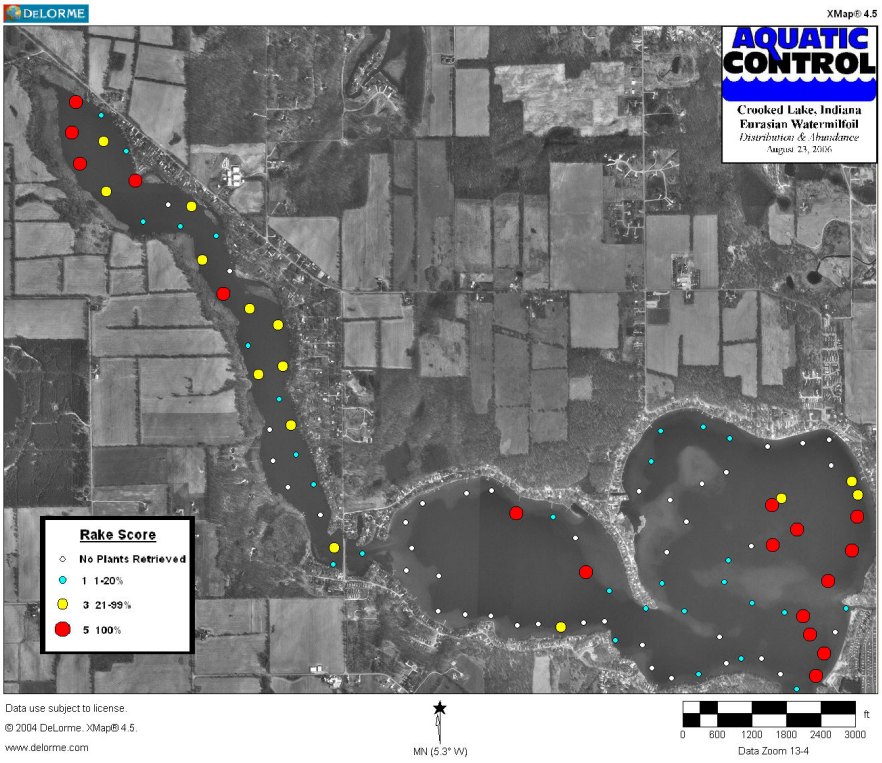

Figure 13. Crooked Lake, Eurasian watermilfoil distribution and abundance, August 23, 2006.

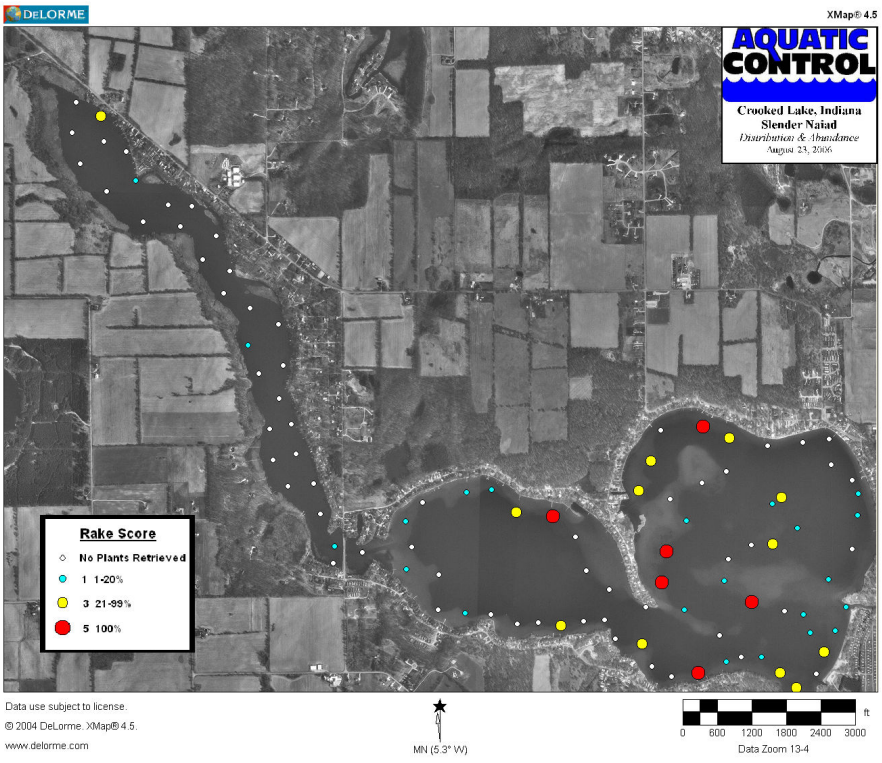

Figure 14. Crooked Lake, slender naiad distribution and abundance, August 23, 2006.

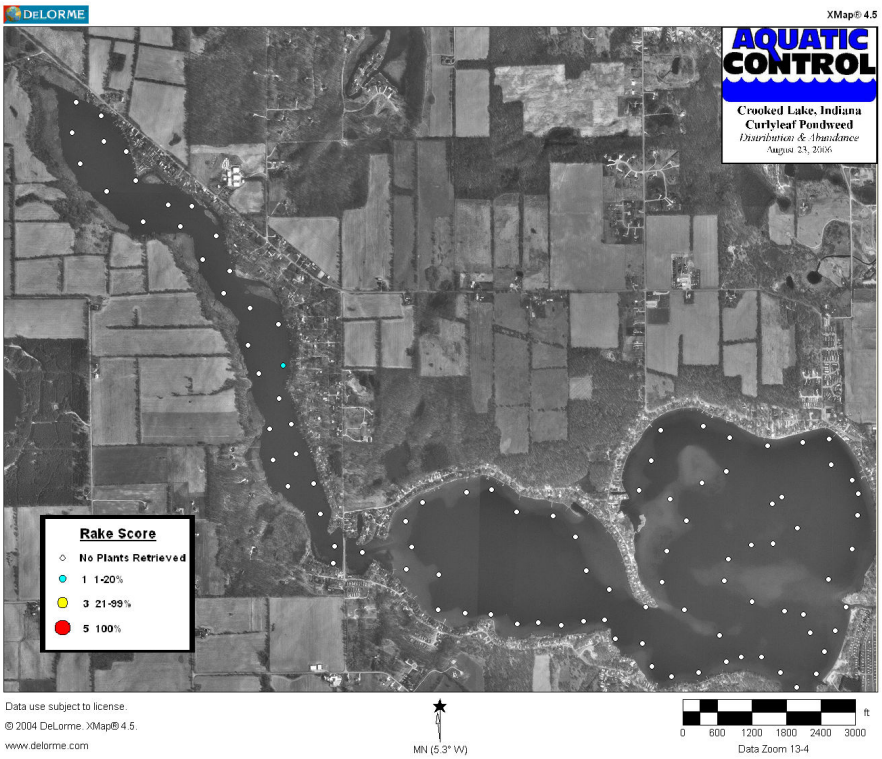

Figure 15. Crooked Lake, curlyleaf pondweed distribution and abundance, August 23, 2006.

8.3 Macrophyte Survey Discussion

Crooked Lake contains a relatively diverse aquatic plant community. Thirty-five different aquatic species were documented in the Tier I and II surveys. Large areas of the third basin contain beneficial beds of rooted floating and emergent vegetation. This shoreline vegetation likely provides many benefits to the overall health of Crooked Lake and should be preserved. There is also a good diversity of native submersed species, especially in the third basin. However, despite a good diversity of native submersed species, they are present in relatively low densities in the first and second basin. The reason for this may be a combination of the soil type, shoreline development, and high-speed boating. This combination likely leads to too much wave action for large beds of submersed vegetation to establish in littoral areas. Much of the shallow water in the first and second basin actually resembles a sandy beach. This may be nice for swimming and boating, but is probably not the best situation for fish production and the overall health of Crooked Lake.

Another interesting phenomenon discovered during sampling is the lack of dense common coontail (*Ceratophylum demersum*) beds. Typically, this species inhabits the deeper areas of natural lakes in northern Indiana, but was surprisingly lacking in Crooked Lake. It appears that Eurasian watermilfoil has supplanted coontail in these deeper areas or conditions are not ideal for dense coontail growth.

The presence of Eurasian watermilfoil at such high densities is the main plant management concern. This species was topped out over large areas of the lake during

the spring survey and present at 60% of sample sites during the summer survey. As previously discussed, this species can lead to a wide variety of environmental and recreational problems. In the late 1990's there was concern over why this species had disappeared without being treated. This same phenomenon was experienced on Webster Lake in 2006 (for more information on reduction of Eurasian watermilfoil of Webster Lake refer to the 2006 Webster Lake Aquatic Vegetation Management Plan Update). However, the milfoil on Webster Lake was replaced by common coontail.

9.0 AQUATIC PLANT MANAGEMENT ALTERNATIVES

Crooked Lake contains a somewhat diverse native aquatic plant community that is beneficial to the overall quality of the lake. However, the abundance of dense beds of Eurasian watermilfoil is a cause of concern. This species can create a variety of problems if left unchecked. Eurasian watermilfoil can negatively impact native species abundance, create nuisance conditions, and also negatively effect fish populations. Once established, growth and physiological characteristics of Eurasian watermilfoil enable it to form a surface canopy and develop into immense stands of weedy vegetation, out competing most submersed species and displacing the native plant community (Madsen et al., 1988). Many effective control techniques are available for targeting this species. Curlyleaf pondweed and purple loosestrife are also species that should be considered for control.

In order to develop a scientifically sound and effective action plan for control of nuisance vegetation, all aquatic management alternatives need to be considered. The alternatives that will be discussed include: no action; institutional; environmental manipulation; mechanical control; manual control; biological control; chemical control; and any combination of these methods.

A number of different techniques have been successfully used to control nuisance vegetation. These techniques vary in terms of their efficacy, rapidity, and selectivity, as well as the thoroughness and longevity of control they are capable of achieving. Each technique has advantages and disadvantages, depending on the circumstances. Selectivity is a particularly important characteristic of control techniques. Nearly all aquatic plant control techniques are at least somewhat selective, in that they affect some plant species more than others. Even techniques such as harvesting that have little selectivity within the areas to which they are applied can be used selectively, by choosing only certain areas in which to apply them. Selectivity can also occur after the fact, as when a technique controls all plants equally but some grow back more rapidly. One facet of selecting an appropriate aquatic plant control technique is matching the selectivity of the control technique with the goals of aquatic plant management. When controlling Eurasian watermilfoil, for example, it is typically desirable to use techniques that control Eurasian watermilfoil with minimal impact on most native species (Smith, 2002).

9.1 No Action

What if no aquatic plant management activity took place on the Crooked Lake? Past management practices have included herbicide treatments of selected shoreline area and

whole basin treatments using fluridone. The contact treatments were successful for short-term control of nuisance species, while the fluridone treatment provided 1-3 years of relief from Eurasian watermilfoil in the third basin. Milfoil's primary mode of reproduction is through fragmentation, so it did not take long for fragments from the first and second basin to infest the third basin following the fluridone treatment. Steps should be taken that provide longer-term control which includes effective techniques on all three basins. These controls will likely never eliminate the invasive species, but will slow their spread and reduce their abundance to a more manageable level.

9.2 Institutional-Protection of Beneficial Vegetation

Presence of beneficial vegetation can inhibit the growth of species which may be more prone to create nuisance conditions. For example, if a bed of largeleaf pondweed is controlled, that area will likely be quickly infested by Eurasian watermilfoil. Largeleaf pondweed rarely reaches the surface and if it does, it typically does not develop the density of a milfoil bed. Dense milfoil beds are impossible to boat across, difficult to fish, and provide poor habitat. On the other hand, largeleaf pondweed rarely reaches the density of Eurasian watermilfoil and provides excellent habitat for fish and aquatic invertebrates. Many associations attempt to control all vegetation. This can create a competitive advantage for aggressive species like Eurasian milfoil which can quickly colonize a controlled area. Protection of beneficial vegetation should be part of any vegetation management plan.

As mentioned in section 8.3, beneficial vegetation may have difficulty rooting in Crooked Lake's sandy substrate due to wave action caused by pleasure boaters. Limiting boating in certain areas may allow for more beneficial vegetation to take root. The Association is currently exploring options for implementing eco-zones that would limit boat activity in certain sensitive areas that appear to be suffering from too much wave action caused by high levels of boat traffic. The long shallow points in the first basin may be areas that should be considered for eco-zones.

9.3 Environmental Manipulation

9.3.1 Water Level Manipulation

Water level manipulation refers to the raising of water levels to control aquatic vegetation by drowning or lowering to control aquatic vegetation by exposing them to freezing, drying or heat. Use of water level manipulation for aquatic plant management is limited to lake and reservoirs with adequate water control structures. Crooked Lake does not have water control structures designed for this purpose, so this technique should not be considered.

9.3.2 Nutrient Reduction

Plant growth can be limited if at least one nutrient, which is critical for growth, is in short supply. Nitrogen, phosphorus or carbon are usually the nutrients limiting plant growth in lakes. It is also Therefore, if at least one of these nutrients can be limited sufficiently so that plants do not grow to a nuisance level, this nutrient limitation can be used as a method of aquatic plant management. Generally, however, plants in northern Indiana can

obtain the majority of necessary nutrients from the soil. Reduction of turbidity can actually aggravate an existing problems by increasing light penetration leading to an expansion in plant growth (Hoyer & Canfield, 1997). However, in certain situations, nutrient reduction can be effective at controlling overabundant floating vegetation or microscopic algae blooms.

Phosphorus is typically the limiting nutrient for plant growth in Midwestern waters. There are several ways of controlling the amount of phosphorus in a body of water. One way is to chemically deactivate the nutrient by using aluminum sulfate. Aluminum sulfate creates a chemical bond with the phosphorus that locks it and keeps it from being used by plants. Another way to control the amount of phosphorus coming into a body of water is through watershed management. Creating a margin of native wetland obligate plants between the lake and terrestrial areas can help to filter some of the nutrients form surface flow water and reduce the amount of shoreline erosion. It is also recommended that fertilizing in the watershed be limited to the use of low or no phosphorus fertilizers.

9.4 Mechanical Control-Harvesting, Cutting, Dredging

Mechanical control includes cutting and/or harvesting of aquatic vegetation or dredging the bottom sediments to eliminate aquatic plant growth. The main advantage to mechanical control is the immediate removal of the plant growth from control areas and the removal of organic matter and nutrients.

One of the most common mechanical control techniques used on larger lakes in Indiana is mechanical harvesting. Mechanical harvesting uses machines which cut plant stems and, in most cases, pick up the cut fragments for disposal. This type of mechanical control has little selectivity. Where a mix of Eurasian watermilfoil and native species exists, harvesting favors the plant species that grow back most rapidly following harvesting. In most cases, Eurasian watermilfoil recovers from harvesting much more rapidly than native plants. Thus, repeated harvesting hastens the replacement of native species by Eurasian watermilfoil and often leads to dense monocultures of Eurasian watermilfoil in frequently harvested areas. Harvesting also stirs up bottom sediments thus reducing water clarity, kills fish and many invertebrates, and hastens the spread of Eurasian watermilfoil via fragmentation.

Dredging of shallow areas may reduce nuisance conditions caused by vegetation in the short-term, but studies and personal experience have shown that Eurasian watermilfoil is often the first species to colonize these disturbed areas. Dredging is expensive, especially if a nearby disposal sight is not available. Careful consideration to secondary environmental effects must be considered and permits from regulatory agencies are usually necessary before conducting dredging operations. Dredging is usually short lived if not done deeper than the photic zone.

9.5 Manual Control-Hand Pulling, Cutting, Raking

Removal of small amounts of vegetation by hand, which interfere with beach areas or boat docks, may be the only vegetation control necessary in some areas. Of course, hand removal is labor intensive and must be conducted on a routine basis. The frequency and practicality of continued hand removal will depend on availability of labor, regrowth or reintroduction potential of the vegetation, and the level of control desired (Hoyer & Canfield, 1997). Residents of Crooked Lake have the option to harvest areas of submersed vegetation in and around their docks or swimming areas. Residents should keep in mind that only a 625 square foot area can be harvested without obtaining a permit from IDNR.

9.6 Biological Controls

Biological controls reduce aquatic vegetation using other organisms that consume aquatic plants or cause them to become diseased. The main biological controls for nuisance vegetation used in Indiana are the grass carp, milfoil weevil, and a variety of insects which prey upon purple loosestrife. Any use of biological controls or stocking fish in public waters in Indiana requires a permit from the IDNR Division of Fish and Wildlife.

9.6.1 Grass Carp

The grass carp (*Ctenopharyngodon idella)* is an herbivorous fish imported from Asia. Triploid grass carp, the sterile genetic derivative of the diploid grass carp, are legal for use in Indiana, but are not permitted for stocking in any natural lakes in the state. Grass carp tend to produce all or nothing aquatic plant control. It is very difficult to achieve a stocking rate sufficient to selectively control nuisance species without eliminating all submersed vegetation. They are not particularly appropriate for Eurasian watermilfoil control because this species is low on their feeding preference list; thus, they eat most native plants before consuming Eurasian watermilfoil (Smith, 2002). Grass carp are also difficult to remove from a lake once they have been stocked. Due to the legal concerns and effectiveness of the grass carp to correct the problem, grass carp are not recommended for nuisance vegetation control in Crooked Lake.

9.6.2 Milfoil Weevil

The milfoil weevil, *Euhrychiopsis lecontei,* is a native North American insect that consumes Eurasian and Northern watermilfoil. The weevil was discovered following a natural decline of Eurasian watermilfoil in Brownington Pond, Vermont (Creed and Sheldon, 1993), and has apparently caused declines in several other water bodies. Weevil larvae burrow in the stem of Eurasian watermilfoil and consume the vascular tissue thus interrupting the flow of sugars and other materials between the upper and lower parts of the plant. Holes where the larvae burrow into and out of the stem allow disease organisms a foothold in the plants and allow gases to escape from the stem, causing the plants to lose buoyancy and sink (Creed et al. 1992).

Concerns about the use of the weevil as a biological control agent relate to whether introductions of the milfoil weevil will reliably produce reductions in Eurasian

watermilfoil and whether the resulting reductions will be sufficient to satisfy users of the lake (Smith, 2002). Following our research, no conclusive data concerning the role of weevils in reducing Eurasian watermilfoil populations has been made available. In 2003, Scribailo and Alix conducted a weevil release study on three Indiana lakes and had no conclusive evidence supporting the use of weevils in reducing milfoil populations. Weevils may reduce milfoil populations in some lakes, but predicting which lakes and how much, if any, control will be achieved has not been documented (Scribailo & Alix, 2003).

9.6.3 Purple Loosestrife Insects (Summarized from JFNew & Associates, 2005)
Some control of purple loosestrife has been achieved through the use of several insects. A pilot project in Ontario, Canada reported a decrease in 95% of the purple loosestrife population from pretreatment population (Cornell Cooperative Extension, 1996 cited in JFNew, 2005). Four different insects were used to achieve this control. These insects have been identified as natural predators of purple loosestrife in its native habitat. Insect releases in Indiana to date have had mixed results. After six years, the loosestrife of Fish Lake in LaPorte County is showing signs of deterioration. Likewise, seven years after the release at Pleasant Lake in St. Joseph County, purple loosestrife populations appear to have declined around the boat ramp (IDNR, 2004 cited in JFNew, 2005). Biological control is not a quick solution; many estimates suggest that it may take 5-15 years to achieve a large impact on purple loosestrife populations.

9.7 Chemical Control

Chemical control uses chemical herbicides to reduce or eliminate aquatic plant growth. The main disadvantage to the use of chemicals is the publics concern over safety. Extensive testing is required of aquatic herbicides to ensure that the herbicides are low in toxicity to human and animal life and they are not overly persistent or bioaccumulated in fish or other organisms. It often takes several decades of testing by the Environmental Protection Agency (E.P.A.) before a herbicide is approved for aquatic use. After E.P.A approval and registration, the herbicide must go through the registration process in each state.

Another disadvantage to the use of aquatic herbicides is water use restrictions. These restrictions must be posted prior to treatment on a public body of water. The most common restriction is irrigation. Another disadvantage to the use of herbicides is the release of nutrients that can occur if large areas of vegetation are controlled. This can be avoided by early application that controls vegetation before it reaches its maximum biomass. These perceived disadvantages are often times out-weighed by this technique's proven rapid effectiveness and selectivity.

There are two different types of aquatic herbicides, systemic and contact. Systemic herbicides are translocated throughout the plants and thereby kill the entire plants. Fluridone (trade name Sonar & Avast!), 2,4-D (trade name Navigate, Aqua-Kleen, & DMA4 IVM), and triclopyr (trade name Renovate) are systemic herbicides that can

effectively control Eurasian watermilfoil. Triclopyr, imazypry, and glyphosate are systemic herbicides that can control purple loosestrife.

Based upon the author's experience and personal communication with an array of North American aquatic plant managers, whole-lake fluridone applications are by far the most effective means of controlling Eurasian watermilfoil. Successful fluridone treatments yield a dramatic reduction in the abundance of Eurasian watermilfoil, often reducing it to the point that Eurasian watermilfoil plants are difficult to detect following treatment (Smith, 2002). An advantage to using fluridone over most contact herbicides is its selectivity. Most strains of Eurasian watermilfoil have a lower tolerance to fluridone than the majority of native species, so if the proper rates are applied Eurasian water milfoil can be controlled with little harm to the majority of native species.

Aquatic Control has completed whole lake fluridone treatments on two public natural lakes in Indiana. Webster Lake was treated in 1999 and 2002. Re-infestation of Eurasian watermilfoil happened in three years, but that was likely due to the species presence in the immediate watershed (lakes that contained Eurasian watermilfoil in the immediate watershed were not permitted for treatment). Wolf Lake, a 451-acre lake in northwest corner of Indiana, was treated with fluridone in 2004 and no Eurasian watermilfoil has been detected since the treatment. Long-term success of a fluridone treatment is variable from lake to lake. Since milfoil can spread by fragmentation, success of the treatment is dependent on eliminating all of the plants from the watershed.

Triclopyr is a systemic herbicide that has recently been approved for use in aquatics. Triclopyr typically is used for treating isolated milfoil beds as opposed to whole lake treatments. This herbicide is very selective to Eurasian watermilfoil. A study was conducted in 1997 during the registration process of this herbicide. The study found Eurasian watermilfoil biomass was reduced by 99% in treated areas at 4 weeks post-treatment, remained low one year later, and was still at acceptable levels of control at two years post-treatment. Non-target native plant biomass increased 500-1000% by one year post-treatment, and remained significantly higher in the cove plot at two years post-treatment. Native species diversity doubled following herbicide treatment, and the restoration of the community delayed the re-establishment and dominance of Eurasian watermilfoil for three growing seasons (Getsinger et. al., 1997). Triclopyr is a good alternative to fluridone when Eurasian watermilfoil is not abundant throughout an entire water body. It would likely be impossible to completely eliminate Eurasian watermilfoil with this type of herbicide, but an aggressive treatment program could significantly reduce milfoil density and abundance to a more manageable level. Eurasian watermilfoil must be treated everywhere it is located in the lake. The only water use restriction following a triclopyr treatment is irrigation. An assay is needed to monitor the concentration in the water before irrigation can take place. One of the drawbacks to using triclopyr has been the fact that only a liquid formulation has been available. This can dramatically increase costs for treatment in deep water areas. In 2007, a granular formulation called Renovate OTF should be approved for aquatic use in Indiana.

Applied properly, 2,4-D can also yield major reductions in the abundance of Eurasian watermilfoil. Much like triclopyr, treatments must be even and dose rates accurate. This formulation should be used much like Triclopyr. Unlike Triclopyr, 2,4-D can impact the native species coontail. This herbicide can be applied for less cost than triclopyr, but damage will likely occur to coontail. This herbicide should be considered as an alternative to triclopyr applications if the POA's budget is restricted. 2,4-D is also available in liquid and granular formulations.

Contact herbicides can also be effective for controlling submersed vegetation in the short term. The three primary contact herbicides used for control of submersed vegetation are diquat (trade name Reward), endothal (trade name Aquathol), and copper based formulations (trade names Komeen, Nautique, and Clearigate).

Historically, a drawback to the use of contact herbicides has been the lack of selectivity exhibited by these herbicides. However, a study completed by Skogerboe and Getsinger in 2002 outlines how endothal can be used for control of the exotic species curlyleaf pondweed and Eurasian watermilfoil with little effect on the majority of native species. They found early season treatments with endothall effectively controlled Eurasian watermilfoil and curlyleaf pondweed at several application rates with no regrowth eight weeks after treatment. Sago pondweed, eel grass, and Illinois pondweed biomass were also significantly reduced following the endothall application, but regrowth was observed at eight weeks post-treatment. Coontail and elodea showed no effects from endothall at three of the lower application rates. Spatterdock, pickerelweed, cattail, and smartweed were not injured at any of the application rates (Skogerboe & Getsinger 2002). This type of treatment strategy could be applied to lakes that have large areas of both curlyleaf pondweed and Eurasian watermilfoil. Endothal could also be effective the year after whole lake sonar treatments where curlyleaf pondweed typically returns the following season

Diquat and many of the copper formulations are effective fast acting contact herbicides. These formulations are typically used when control of all submersed vegetation is desired. These herbicides are commonly used for control of nuisance vegetation around docks and near-shore high-use areas. Diquat and the copper based herbicides are not as selective as many of the other herbicides and plants can often times recover in 4-8 weeks after treatment. There are no water use restrictions following the use of chelated copper based herbicide, which makes them popular choices for lakes used for irrigation or drinking water.

10.0 PUBLIC INVOLVEMENT

An effective aquatic vegetation management plan must include input from lake users. A public meeting was conducted on September 18, 2006 at a Real Estate Office near Crooked Lake. The meeting was advertised in the local newspaper and on local radio stations. Approximately fifteen individuals attended the meeting.

The goals of the meeting were as follows:

1. Inform lake users of the planning process
2. Document important high-use areas of the lake
3. Educate those in attendance on aquatic plant ecology
4. Describe results of the plant sampling
5. Discuss plant management alternatives
6. Discuss implementation of the potential management strategies and monitoring programs
7. Obtain user input by filling out a survey (see appendix for survey form)

According to surveys forms, everyone in attendance lived on the lake and 93% were members of the association. Sixty-seven percent of those surveyed had lived on the lake for 10 or more years. Ninety-three percent of those surveyed used the lake for boating, 93% for swimming, 67% for fishing, and 40% used the lake for irrigation. On survey questions concerning lake problems; 60% believed dredging was needed, 7% thought there was a fish population problem, 60% believed there were too many jet skis, 7% not enough aquatic plants, 33% too many aquatic plants, 53% thought there was over-use by non-residents, 40% believed pier funneling was a problem, 20% poor water quality, and 47% believed there were too many boats with access to the lake. On survey questions dealing with aquatic vegetation, 47% believed vegetation interfered with lake use, 60% believed it affected property value, and 100% were in favor of continuing vegetation control efforts.

11.0 PUBLIC EDUCATION

In order to effectively manage aquatic vegetation lake users must gain an understanding of the ecology of the lake ecosystem and the effects individual actions may have on this resource. The Crooked Lake Association has been very active in taking steps for improving and maintaining the quality of Crooked Lake. Consultants have been hired to complete studies on the lake and recommendations from these studies are beginning to be implemented. In March of 2005 improvements were made to the Carpenter Drain, which flows into Crooked Lake. On a smaller scale, steps can be taken by individual property owners that will also help preserve and enhance Crooked Lake. The following is a list of potential actions that individuals can undertake:

1. Reduce the frequency and amount of fertilizer, herbicide, or pesticide used for lawn care.
2. Use only phosphorus-free fertilizer.
3. Consider re-landscaping lawn edges, particularly those along the watershed's lakes, to include low profile prairie species that are capable of filtering runoff water better than turf grass
4. Consider resurfacing concrete or wooden seawalls with glacial stone, then planting native emergent vegetation along shorelines or in front of resurfaced or existing concrete or wooden seawalls to provide fish and invertebrate habitat and dampen wave energy.
5. Keep organic debris like lawn clipping, leaves, and animal waste out of the water
6. Properly maintain septic systems. Systems should be pumped regularly and leach fields should be properly cared for.
7. Examine all drains that lead from roads, driveways, and rooftops to the watershed
8. Obey speed limits through the lakes
9. Clean all plant fragments and sediment from boats, propellers, and trailers after lake use and refrain from dumping bait buckets into the lake to prevent the spread of exotic species (JFNew, 2005). Additional information on stopping the spread of exotic species can be found at www.protectyourwaters.net.

These points should be reinforced annually at Association meetings and in newsletters or on websites.

12.0 INTEGRATED MANAGEMENT ACTION STRATEGY

The focus of the action strategy should be designed to meet the goals and objectives of the aquatic plant management plan. To review, the goals are as follows:

1. Develop or maintain a stable, diverse aquatic plant community that supports a good balance of predator and prey fish and wildlife species, good water quality, and is resistant to minor habitat disturbances and invasive species
2. Direct efforts to preventing and/or controlling the negative impacts of aquatic invasive species.
3. Provide reasonable public recreational access while minimizing the negative impacts on plant and fish and wildlife resources.

Each goal, along with objectives to meet this goal, is listed below. Following each objective are the actions which should be taken in order to achieve the objective.

12.1 Goal #1-Maintain Stable and Diverse Native Population

The first goal focuses on developing or maintaining a stable, diverse aquatic plant community. In order to address the objectives for meeting this goal the plant community will be divided into two categories: emergent/floating vegetation and submersed vegetation. The focus of the LARE program is primarily on control of nuisance exotic submersed vegetation, but seeing how this is an aquatic vegetation management plan one cannot ignore the emergent and rooted floating plant community.

Objective 1: Maintain and Enhance Diversity of the Emergent/Rooted Floating Plant Community

The third basin has a dense and diverse shallow wetland plant community, especially along the western side of the third basin. This community serves several beneficial purposes to Crooked Lake that includes reducing erosion, providing fish and wildlife food and habitat, and filtering excessive nutrients. This plant community should be protected from development. Several large homes have lake access and are located within this wetland area. The homeowners have developed far enough back from the wetland area that the impact from this development is less severe. The homeowner's have docks that run through the emergent community out to open water, thus the homeowner's do not have to remove vegetation in order to have lake access. The homeowner's have also allowed emergent vegetation to flourish along their lake property (Figure 16). This should be an example to other homeowner's as a more effective land management practice and should be encouraged in future development and for older residences.

Figure 16. Crooked Lake, emergent plant community along developed shoreline, June, 2006.

The first and second basins are highly developed and lack important shoreline/lake margin vegetation. Most residents have concrete sea walls that provide little benefit to the ecology of Crooked Lake. These residents should be encouraged to allow rooted floating and emergent vegetation to grow in these areas. There is also data that suggests bulrush beds have been lost is several shallow, open water areas. Steps should be taken to re-introduce this in these areas.

As documented, purple loosestrife is present at low levels in two plants beds within Crooked Lake. This plant has the potential to spread and displace beneficial native species. At this time, the LARE program will not fund control of this plant, so it is important that residents take action in securing funds from other sources and conduct their own controls. Residents should become familiar with this species and dig it up if it is found on their property. Biological controls show a lot of promise and are less expensive and controversial than herbicide applications (there are a lot of issues with applying herbicides on private property as opposed to treating the water which is public property). The association should stay abreast of any funding or studies being completed with these biological controls and make all attempts to secure funds.

Objective 2: Maintain diversity of submersed vegetation in the third basin and enhance diversity in first and second basins

Crooked Lake has a good diversity of submersed vegetation, but it is lacking in abundance in the first and second basin. The reason for the lack of density may be due to a combination of the following factors:

1. The first and second basins have sandy substrate that is not the best for rooted vegetation
2. There is a great deal of high speed boating on all of the basins
3. Much of the first and second basin's shoreline is lined with concrete seawalls that amplify wave action
4. The presence of dense stands of Eurasian watermilfoil displaces native species

There is very little that can be done about the substrate of these basins and high speed boating is one of the most popular activities on Crooked Lake, so in order to improve the abundance of native vegetation steps should be taken to reduce milfoil abundance and seawalls. It is unlikely that residents will remove a concrete seawall that they have spent money on to build and maintain, but as these seawalls wear out residents should be made aware of the different options including natural vegetation and/or glacial stone. These materials may help reduce the amplified wave action, which can result in increased turbidity during the summer months. In addition, the Association is currently looking into establishing eco-zones in Crooked Lake. Eco-zone would be buoyed off areas that restrict or limit boating. This limitation on boating in the sensitive areas will likely allow submersed vegetation to take root. Several shallow areas in the first basin would be prime areas for Eco-zones. This may be a controversial undertaking, but would likely have significant positive effects on the Crooked Lake ecosystem.

12.2 Goal #2-Reduce Negative Impacts Caused by Exotic Vegetation

The second goal of the vegetation management plan is to prevent and reduce negative impacts of aquatic invasive species. Goal one and two are somewhat related because one of the negative impacts of invasive species is their tendency to displace beneficial native vegetation.

Objective 1: Reduce and Control Eurasian watermilfoil density and abundance

One of the main invasive species of concern is Eurasian watermifilfoil. Eurasian watermilfoil reproduces through fragmentation and can rapidly reach nuisance levels. This makes it of special concern when it comes to aquatic plant management. This species can also displace native vegetation due to this rapid growth and its tendency to form a canopy shading out native species. This species has been the target of control with contact herbicides, 2,4-D and fluridone. These treatments have been effective in the short term, but milfoil can return within a few months or a few years after treatment with contact herbicides, and systemic herbicides need to applied to all areas of milfoil to reduce chances of reinfestation. When contact herbicides are used to control milfoil there is likely damage to the native plant community.

As discussed earlier in the plan, there are many control techniques that have been used in an attempt to control this Eurasian watermilfoil. Most control techniques have met with good short-term results. However, two chemical control techniques have proven effective for short and long term control of this species. These include whole lake fluridone treatments and triclopyr/2,4-D spot treatments. A whole lake fluridone treatment is not feasible for the first and second basins due to the large volume of water. Whole lake fluridone treatments have proven to be very effective on the third basin, but reinfestation occurred within 1-3 years. With this in mind, it is recommended that all three basins be treated at the same time with different systemic herbicides. It is recommended that all areas where Eurasian watermilfoil is discovered in the first and second basin be treated with triclopyr or 2,4-D herbicide. It is estimated that up to 75 acres will need to be treated in 2007 (this figure was calculated by looking at the spring

2006 Tier I data). Actual treatment areas will be determined following May surveys. The amount of treatment should be reduced by the 2008 season.

Since milfoil is so abundant in the third basin and the third basin is so shallow, a whole basin fluridone treatment would be more cost effective and likely allow for longer-term control of milfoil then a 2,4-D or Renovate treatment. Eurasian watermilfoil is so abundant in the third basin that if 2,4-D or Renovate were used for control, the whole basin would require treatment with these herbicides. The cost of this treatment would be over $50,000. Fluridone is the obvious choice for this treatment. The fluridone treatment should be completed with a goal of achieving an initial 8 ppb concentration and keeping this concentration above 3 ppb for 90 days (8ppb chosen over the standard 6ppb in order to reduce number of bump applications which could be needed due to potential high levels of dilution caused by flow in the third basin). This will require FasTest sampling five days after the initial treatment along with tests every three weeks for 90 days. Three tests should be taken from three different sections of the third basin. If the average of the tests indicate that the concentration is below 4 ppb, a bump treatment should be completed with enough fluridone to bring it back to 6 ppb. This treatment calls for a slightly lower concentration but a longer exposure time than previous fluridone treatments that have been completed on the third basin. This should allow for better selectivity and excellent control of Eurasian watermilfoil. Treating the third basin at the same time as the first and second basin should slow reinfestation. However, it is unlikely that Eurasian watermilfol will ever be eliminated from this waterbody due to its presence in lakes above Crooked Lake. In the future, detection of any new milfoil plants in the third basin should take priority in order to reduce the need for whole basin treatments. Figure 17 illustrates 2007 potential treatment areas.

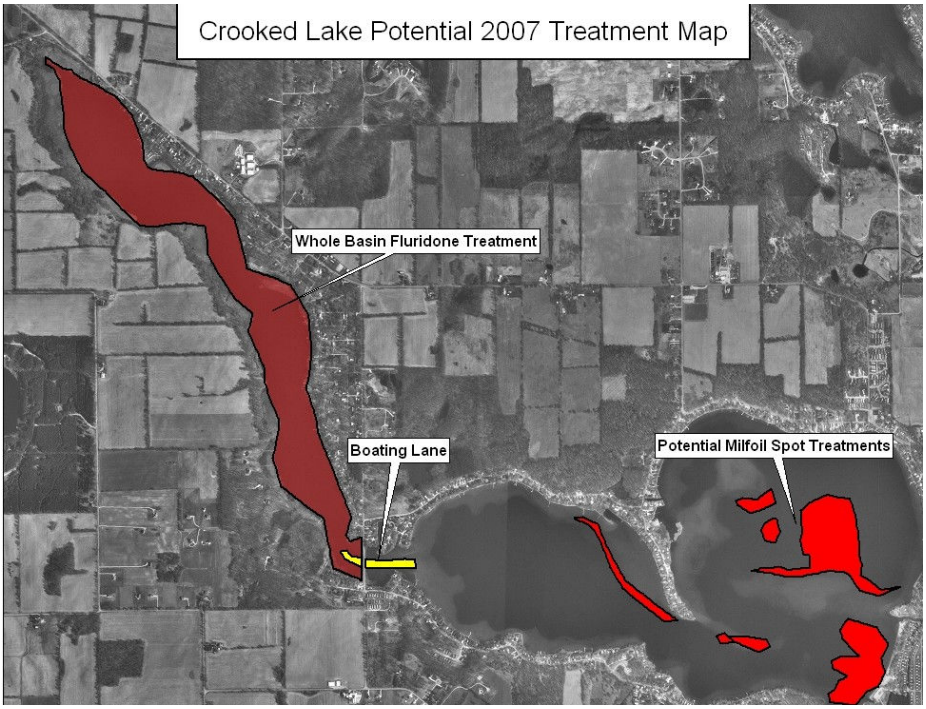

Figure 17. Crooked Lake, potential 2007 treatment areas.

Along with chemical control, it will be important for lake users to do their part in controlling Eurasian watermilfoil. Eurasian watermilfoil spreads through fragmentation, so it is easy to introduce this species to new areas. It is important that boaters avoid driving through any milfoil beds. This can chop up the plants causing them to float into new areas. It is also important that boaters check their props and trailers when traveling from lake to lake removing any plant fragments. One fragment of milfoil can lead to an entire colony. Signs should also be placed at all access points warning boaters to check for plant fragments. This is especially important since the discovery of hydrilla (*Hydrilla verticillata)* in Lake Manitou.

Objective 2: Prevent further spread of Purple Loosestrife
As mentioned when discussing goal number one, purple loosestrife can be detrimental to native wetland species. Control of this species may be funded by LARE depending on availability and prioritization of funds.

There are chemical controls that are very effective on this species, but due to the extent of the infestation it is not economically feasible to hire an outside contractor to spray the entire shoreline of the Crooked Lake. It will be important to individual homeowners to dig up and remove the entire plant. An illustration of this species can be seen in Figure 5 and a picture of this plant taken at Crooked Lake is below in Figure 18.

Figure 18. Purple Loosestrife in Crooked Lake, June, 2006.

Objective 3: Monitor curlyleaf pondweed and begin controls in 2008
The exotic species, curlyleaf pondweed is common to northern Indiana lakes, and was found during surveys of Crooked Lake. Historically, control of this species has not been funded by the LARE program due to limitations on funding that require prioritization of the most aggressive species. Curlyleaf pondweed tends to senesce during the busy summer season. After Eurasian watermilfol is under control it may become

economically feasible to begin controlling curlyleaf pondweed. This species will likely be the primary nuisance species in the spring of 2008 if Eurasian watermilfoil controls are initiated. Control of this species will require multiple seasons of treatment due to the presence of curlyleaf pondweed turions, which may last several seasons after treatment. As previously mentioned, low dose endothal treatments are effective for selective control of curlyleaf pondweed. It is estimated that up to 245 acres would need treated for three consecutive seasons. This treatment should not be initiated until 2008 since the third basin will likely be treated with fluridone in 2007. The cost of this type of treatment would likely be over $70,000 per season.

Objective 4: *Create public awareness of the potential for hydrilla invasion and post signs for cleaning off boats at all private and public access sites*
Hydrilla, an extremely aggressive submersed aquatic plant species, has been recently discovered in Lake Manitou, which is located in north central, Indiana. Currently, it is believed that this plant is isolated in the Lake Manitou area, but much like Eurasian watermilfoil, this species has the ability to reproduce by fragmentation. This allows it to be spread easily from lake to lake. It is very important that lake users understand the importance of thoroughly cleaning off their boats when entering and exiting Flint Lake. Posting signs at the ramp will help reinforce this point. Warnings about this plant should also be sent to members of the Association. The best way to distinguish hydrilla from native elodea is that hydrilla typically has five leaves along each whorl along with visible serrated edges along the leaf margin (Figure 14). More information about controlling the spread of hydrilla can be found at www.protectyourwaters.net. An illustration of hydrilla and native elodea follows in Figure 19.

Figure 19. Illustration of hydrilla on the left compared to native elodea on the right. Hydrilla typically contains five toothed leaves per whorl while native elodea typically has three leaves per whorl and the teeth are not visible on the leaves (Illustrations provided by Applied Biochemist).

12.3 Goal #3: Provide Reasonable Recreational Access While Minimizing the Negative Impacts on Plant, Fish, and Wildlife Resources

The focus of plant control should be on nuisance exotic species, but even if all exotic species were eliminated it will be necessary to control some native plants in order to provide access to docks, boat ramps, and travel routes between lakes. This will require control of some submersed and rooted-floating native species. Below are two objectives that will be used in order to meet this goal

Objective 1: Keep boating lanes open between basins, in channels, and in and around the public access site.

The boating lane between the second and third basin has the potential to become blocked by native vegetation (it was stated in the 1966 fish survey report that this area was "choked" with rooted floating vegetation). This area may need to be controlled in order to allow boats to pass without becoming entangled in vegetation. Glyphosate, triclopyr, and imazipyr-based herbicides all provide inexpensive and effective long-term control of rooted floating vegetation. Treatment should not exceed the area needed for boat navigation. Treatment of submersed vegetation may also be necessary in the channels on Crooked Lake. The channels are man-made areas that are typically shallow and can become easily impaired due to their narrow design. Treatment should also be completed in and around the public access site if needed (there was not a problem with access in 2006, but this area does have the potential for nuisance growth).

Objective 2: Control vegetation around docks in order to allow for boat access

If left unchecked, many homeowners' would be locked into their dock areas by submersed and rooted floating vegetation, especially in the shallow third basin. Some homeowners may have the ability to physically remove the vegetation from these areas (625 square feet can be removed without a permit). It is recommended that if possible, homeowner's control the 625 square feet. However, some areas may be too dense or some homeowners may not be capable of completing this task. In this case it will be necessary to contact professionals to complete the work. Applied properly, aquatic herbicides are typically the best method for control of dense vegetation growth. Treatment should be limited to allowing access to ones dock. Width of shoreline treatment should not exceed 100 feet out from shore for treatment of submersed vegetation and treatment of rooted floating vegetation should be limited to a wide enough area for boats to pass (20-30 feet).

12.4 List of Actions To Be Initiated

The purpose of the LARE grant was to fund aquatic vegetation control on public lakes. Listed below, in order of importance, are recommended actions in order to meet the goals and objectives of the aquatic vegetation management plan. Some of these actions may be funded by LARE, but many will require funds from the Association.

1. Initiate treatment of Eurasian watermilfoil with triclopyr or 2,4-D herbicide in the first and second basin. Treatment should take place anywhere this species occurs in an attempt to reduce density and abundance to a manageable level and slow

reinfestation of the third basin. Initiate treatment of the third basin with fluridone. Treatments should take place in the spring of 2007.

2. Monitor plant community with plant surveys for next five years in order to assess the effectiveness of controls and response of native plant community. Plant surveys will also be invaluable to quickly detect and control potential reinfestation of the third basin. Surveys should include spring treatment map surveys along with summer Tier II surveys.
3. Post signs at all access sites in warning boaters of the potential for invasive plant species introductions from boat trailers. Signs should implore boaters to clean trailers, props, and boats of all vegetation fragments when entering and leaving Crooked Lake.
4. Continue to explore the possibility of establishing Eco-zones in order to reduce wave action in sensitive areas.
5. Monitor curlyleaf pondweed population and consider control in 2008 after Eurasian watermilfoil is reduced.
6. Remove purple loosestrife from individuals' property and pursue funding source to biological controls.
7. Maintain boating lanes between the basins with herbicide applications.
8. Maintain dock areas with physical plant removal when possible or by contracting professional applicators. Treatments should not exceed 100 feet from shoreline for submersed vegetation and treatment of rooted floating vegetation should be limited to boating lanes.
9. Educate lake users on best management practices in order to improve water quality.
10. Act on recommendations laid out in the watershed study.
11. Control native vegetation only in areas where boat access is hampered by its growth.
12. Work with lakes in the watershed in an attempt to get them actively controlling exotic species and improve water quality.

13.0 PROJECT BUDGET

Table 8 is an estimated budget for the aquatic vegetation management action plan. The majority of the cost will be for the control of Eurasian watermilfoil. This cost should decrease over the next five seasons and hopefully by 2011 the amount of Eurasian watermilfoil will be at a level that is easily managed with Association funds. It is proposed that IDNR fund treatment of milfoil and plant survey updates (this will require a 10% match from the Association). **It is our recommendation that the CLA requests $55,000 for treatment of up to 75 acres of Eurasian watermilfoil in first and second basins with 2,4-D and/or Renovate herbicide and a whole lake treatment of third basin along with $5,000 for plant sampling and plan updates.** It is possible that this project may not be fully funded due to a recent hydrilla infestation in Lake Manitou that may use a large percentage of potential LARE funds. A permit has been created for this treatment and is included in the Appendix. This permit should be handled by the association and once a contractor is selected for the treatment the permit can be completed.

Table 8. Budget estimate for action plan (2008-2011 curlyleaf treatment not included, but may be added based on spring 2007 sampling).

	2007	2008	2009	2010	2011
Treatment of Eurasian watermilfoil with Renovate or 2,4-D (Potential LARE funding with 10% match)	$30,000	$25,000	$20,000	$15,000	10,000
Whole Lake Fluridone treatment in third basin (Potential LARE funding with 10% match)	$25,000	-	-	-	-
Plant sampling and plan updates (potential LARE funding with 10% match)	$5,000	$5,000	$5,000	$5,000	$5,000
Total:	**$60,000***	**$30,000**	**$25,000**	**$20,000**	**$15,000**

*Request $60,000 from LARE program in 2007.

14.0 MONITORING AND PLAN UPDATE PROCEDURES

One of the most important actions in the aquatic vegetation management plan is the continued monitoring of the plant population. Continued monitoring will provide valuable data to the aquatic plant manager. This data can be used to complete the following tasks: allow for needed changes to be made to the plan; monitor success or failure of controls; monitor improvements or damage to native plants; and detect potential new invasive species at an early stage of infestation. Monitoring should consist of a visual survey prior to the Eurasian watermilfoil treatment in order to create a treatment map for the milfoil spot treatments in first and second basin. In addition, a curlyleaf pondweed treatment map should also be created for all three basins that can be used to assess the feasibility of a curlyleaf treatment in 2008. A Tier II survey should be completed in July or August. The Tier II survey provides managers with quantitative data that can point out trends in the plant community. Each winter this data should be analyzed and included in an update to the aquatic vegetation management plan. The surveys may lead to changes in the recommended actions of the plan.

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16.0 APPENDICIES

16.1 Data Sheets

Tier 1

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Aquatic Control

Waterbody Name: Crooked Lake ID: None

County: Steuben Date: 6-14-06

Habitat Stratum: IL Ave. Lake Depth (ft): Lake Level: Normal

GPS Metadata

Crew Leader: N. Long

Datum:	Zone:	Accuracy:
NAD27	16	3M

Recorder: K. McCreary Method: D

Secchi Depth (ft): 8 Total # of Plant Beds Surveyed: 32 Total # of Species: 27

Littoral Zone Size (acres): 479.9

- [x] Measured
- [ ] Estimated

Littoral Zone Max. Depth (ft): 13

- [x] Measured
- [ ] Estimate (historical Secchi)
- [ ] Estimated (current Secchi)

Notable Conditions:

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 01
Bed Size: 2.8
Substrate: 02
Marl? 0
High Organic? 1

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 8

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

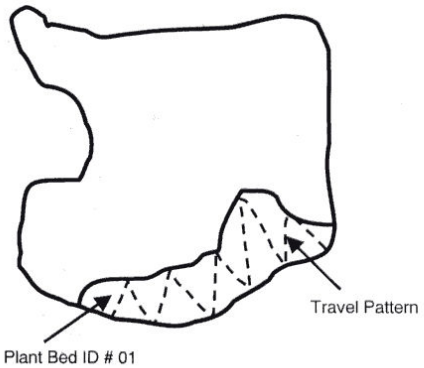
Center of the Bed
Latitude: N41.67073
Longitude: W85.03252

Max. Lakeward Extent of Bed
Latitude: N 41.67080
Longitude: W 85.03524

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3	0	0	
ELCA7	3	1	0	
CEDE4	2	0	0	
POCR3	2	0	0	
WOLF	1	2	0	
PO2O	1	0	0	
POPE6	1	0	0	
PORI2	1	0	0	

Individual Plant Bed Survey



Comments:

Channel Submersed
Secchi 8ft
Max Plant D-13ft

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 02
Bed Size: 0.1
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 9

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 3

SITE COORDINATES

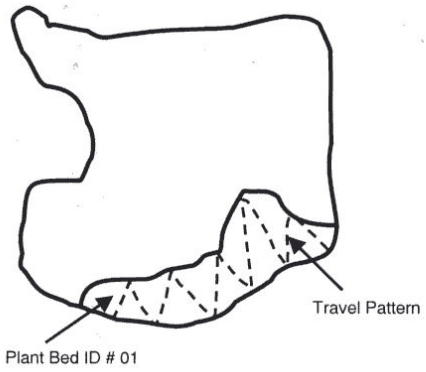
Center of the Bed
Latitude: —
Longitude: —

Max. Lakeward Extent of Bed
Latitude: N41.67086
Longitude: W85.63395

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	3	1	0	
NYTU	1	0	0	
DIAM	2	0	0	
LYSA	1	0	0	
TYLA	2	0	0	
SCVA	1	0	0	
POCR3	1	0	0	
MYSP2	1	0	0	
WOLF	1	2	0	

Individual Plant Bed Survey



Comments:

Scattered Emergents / Shoreline Plants

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 03
Bed Size: 196.55
Substrate: 6
Marl? 0
High Organic? 0

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 6

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

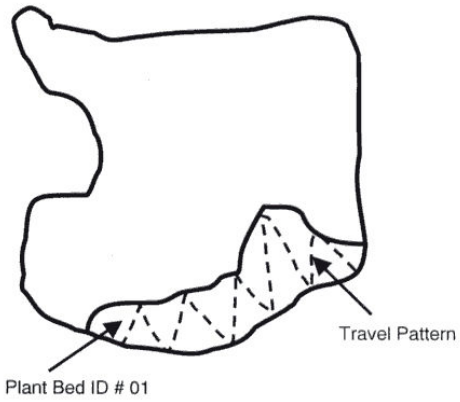
Center of the Bed
Latitude: Can't Define
Longitude:

Max. Lakeward Extent of Bed
Latitude: N41.67202
Longitude: W85.64470

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CHRA	1	2	0	
PORI2	1	0	0	
MYSP2	1	0	0	
POCR3	1	0	0	
NYTU	1	0	0	
VAAM3	1	0	0	

Individual Plant Bed Survey



Comments:

Sparse Vegetation
Very sandy substrate
like a beach!

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control **DATE:** 6-14-06

SITE INFORMATION

Plant Bed ID: 04
Bed Size: 0.3
Substrate: 2
Marl? 0
High Organic? 0

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 4

CanopyAbundance at Site

S:	N:	F:	E:
2	1	1	1

SITE COORDINATES

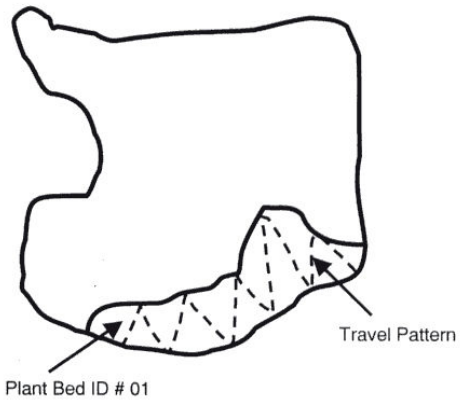
Center of the Bed
Latitude: N41.67234
Longitude: W85.04455

Max. Lakeward Extent of Bed
Latitude: N41.67245
Longitude: W85.04409

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3	0	0	
POCR3	3	0	0	
POPU7	1	1	0	
CEDE4	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 05

Bed Size: 30.1

Substrate: 3

Marl? 0

High Organic? 0

Waterbody Name: Crooked Lake

Waterbody ID:

Total # of Species

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67432

Longitude: W85.03906

Max. Lakeward Extent of Bed

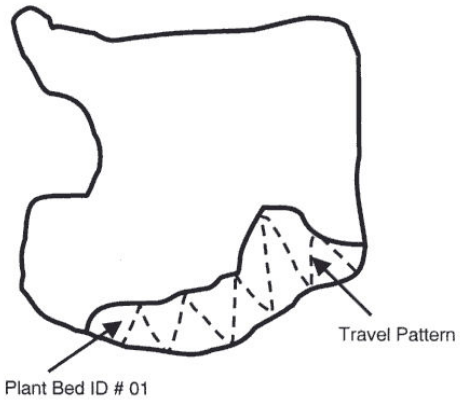
Latitude: N41.67292

Longitude: W85.04378

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POPE6	1	0	0	
NAFL	1	1	0	
NYTU	1	0	0	
POBI2	1	0	0	
POPU7	1	0	0	
POCR3	2	0	0	
CEDE4	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 6 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 06
Bed Size: 2.2
Substrate: 3
Marl? 0
High Organic? 0

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 5

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

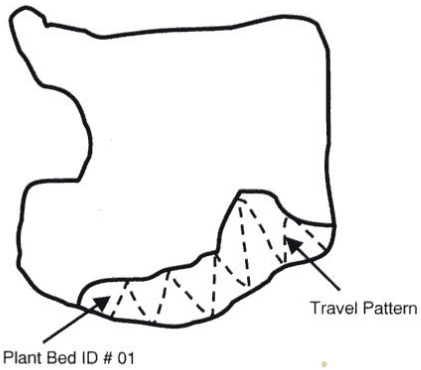
Center of the Bed
Latitude: N41.67470
Longitude: W85.04263

Max. Lakeward Extent of Bed
Latitude: N41.67419
Longitude: W85.04280

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	1	0	0	
POCR3	2	0	0	
POPEC	1	0	0	
POPU7	1	1	0	
NYTU	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 7 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 07
Bed Size: 2.8
Substrate: 03
Marl? 0
High Organic? 1

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 4

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

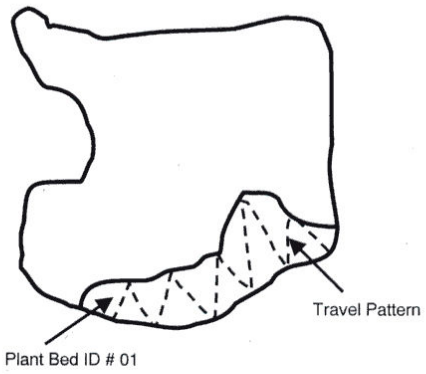
Center of the Bed
Latitude: N41.67590
Longitude: W85.04352

Max. Lakeward Extent of Bed
Latitude: N41.67550
Longitude: W85.04395

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	2	0	0	
POPE6	1	0	0	
NYTU	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
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3 = 21-60%
4 = > 60%

QE Code:
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2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 8 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Coulter | DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 08
Bed Size: 0.2
Substrate: 02
Marl? 0
High Organic? 1

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 4

CanopyAbundance at Site

S: 1 | N: 1 | F: 2 | E: 3

SITE COORDINATES

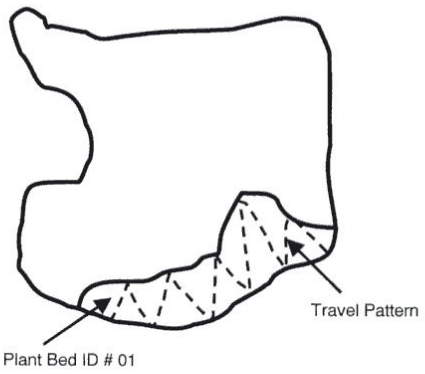
Center of the Bed
Latitude: N41 67146
Longitude: W85.03484

Max. Lakeward Extent of Bed
Latitude: N41.67157
Longitude: W85.03473

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
TYLA	3	0	0	
NULU	2	0	0	
CHRA	1	2	0	
PORI	1	1	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 9 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 09
Bed Size: 40.3
Substrate: 3
Marl? 0
High Organic? 0

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 6

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

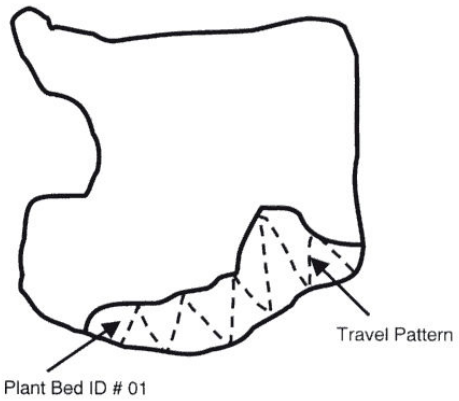
Center of the Bed
Latitude: —
Longitude: —

Max. Lakeward Extent of Bed
Latitude: N41.67039
Longitude: W85.04185

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POCR3	3	0	0	
MYSP2	2	0	0	
CEDE4	2	0	0	
NYTU	1	0	0	
POPU7	1	0	0	
POR1	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 16 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 10
Bed Size: 3.0
Substrate: 3
Marl? 0
High Organic? 0

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 13

CanopyAbundance at Site

S: 1 N: 1 F: 2 E: 1

SITE COORDINATES

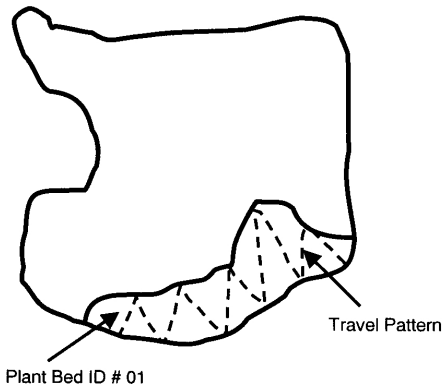
Center of the Bed
Latitude: N41.67459
Longitude: W85.04377

Max. Lakeward Extent of Bed
Latitude: N41.67552
Longitude: W85.04883

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
ZAPA	2	0	0	
CHRA	2	2	0	
BRSC	2	0	0	
NYTU	1	0	0	
MYSP2	1	0	0	
POPU7	1	1	0	
NAFL	1	1	0	
VAAM3	1	0	0	
POAM	1	0	0	
POIL	1	1	0	
TYLA	2	0	0	
POCO	2	0	0	
NULU	2	0	0	

Individual Plant Bed Survey



Comments:

Very Diverse Native
Spp Area
Little shoreline development

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

AQUATIC CONTROL

Aquatic Vegetation Plant Bed Data Sheet

Page 11 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A C.

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 11
Waterbody Name: Crooked
Bed Size: 0.9
Substrate: 3
Waterbody ID:
Marl? 0
Total # of Species 2
High Organic? 1

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

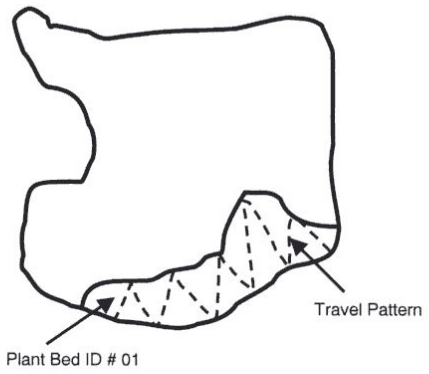
Center of the Bed
Latitude: N41.66981
Longitude: W85.04553

Max. Lakeward Extent of Bed
Latitude: N41.66966
Longitude: W85.04490

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	2	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 12 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 12
Waterbody Name: Crooked Lake
Bed Size: 0.6
Substrate: 03
Waterbody ID:
Marl? 0
Total # of Species 3
High Organic? 0

CanopyAbundance at Site

S:	N:	F:	E:
3	1	1	1

SITE COORDINATES

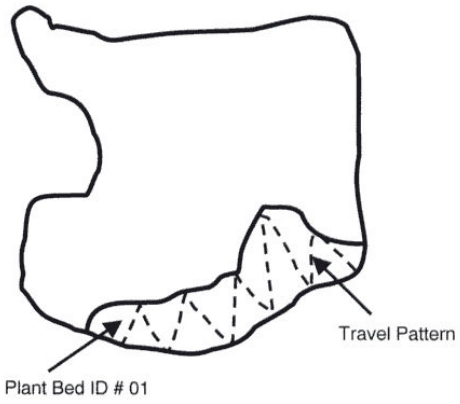
Center of the Bed
Latitude: N41.66959
Longitude: W85.04303

Max. Lakeward Extent of Bed
Latitude: N41.66929
Longitude: W85.04340

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	1	0	0	
POPE16	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
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2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 13 of ___

State of Indiana Department of Natural Resources

ORGANIZATION: A.C

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 13
Bed Size: 19.9
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 6

CanopyAbundance at Site

S: 4 N: 1 F: 1 E: 1

SITE COORDINATES

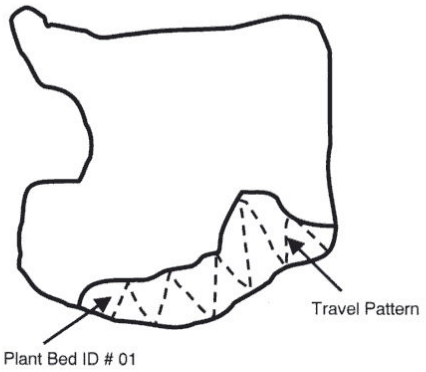
Center of the Bed
Latitude: N41.66356
Longitude: W85.03697

Max. Lakeward Extent of Bed
Latitude: N41.66384
Longitude: W85.03889

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
ELCA7	2	0	0	
POR1	1	0	0	
POPU7	1	1	0	
POPE6	1	0	0	
POCR3	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
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4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 14 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C **DATE:** 6-14-06

SITE INFORMATION

Plant Bed ID: 14
Bed Size: 2.7
Substrate: 2
Marl? 0
High Organic? 1
Waterbody Name: Crooked
Waterbody ID:
Total # of Species 7

CanopyAbundance at Site

S:	N:	F:	E:
2	1	2	1

SITE COORDINATES

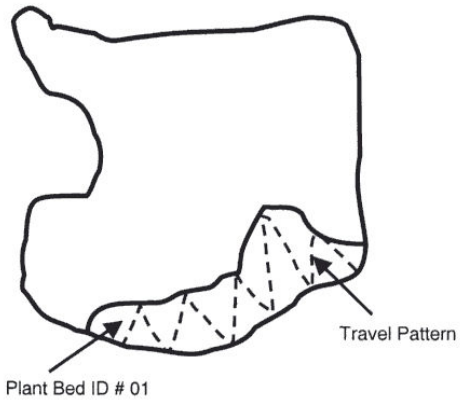
Center of the Bed
Latitude: N41.6666
Longitude: W85.03783

Max. Lakeward Extent of Bed
Latitude: N 41.66736
Longitude: W85 03927

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
TYLA	2	0	0	
NULU	2	0	0	
NYTH	2	0	0	
MYSP2	1	0	0	
POR1	1	0	0	
DIAM	1	0	0	
CEOC	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
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2 = 2-20%
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Abundance:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 15 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 15

Waterbody Name: Crooked

Bed Size: 0.9

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 4

High Organic? 0

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67002

Longitude: W85.06003

Max. Lakeward Extent of Bed

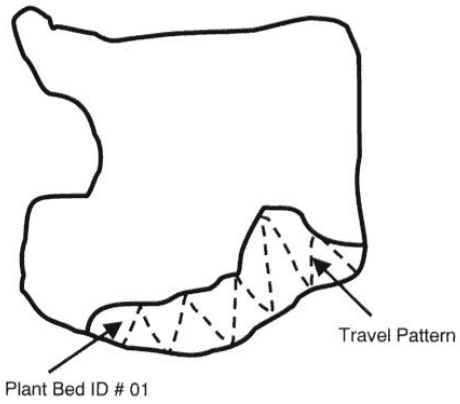
Latitude: N41.67013

Longitude: W85.05992

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	3	0	0	
POCR3	2	0	0	
POPU7	1	1	0	
POPE6	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
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2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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Voucher:
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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 16 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: AC

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 16

Waterbody Name: Crooked

Bed Size: 6.4

Substrate: 02

Waterbody ID:

Marl? 0

Total # of Species

High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67337

Longitude: W85.06517

Max. Lakeward Extent of Bed

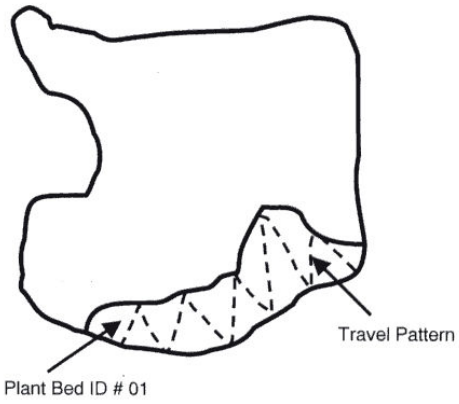
Latitude: N41.67324

Longitude: W85.06420

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	2	0	0	
PORI	2	0	0	
POAM	2	0	0	
POPEG	2	0	0	
CHARA	1	2	0	
POCR3	1	0	0	
POPU7	1	1	0	
VAAM3	1	0	0	
NULU	1	0	0	
RATR	1	1	1	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 17 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 17
Waterbody Name: Crooked Lake
Bed Size: 3.3
Substrate: 2
Waterbody ID:
Marl? 0
Total # of Species 12
High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 4/ E: 1

SITE COORDINATES

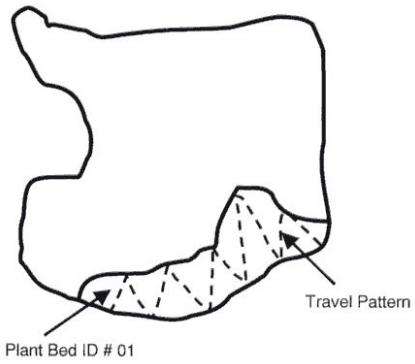
Center of the Bed
Latitude: N41 67301
Longitude: W 85.06632

Max. Lakeward Extent of Bed
Latitude: N41.67354
Longitude: W 85.06526

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
CHRA	1	2	0	
POCO	1	0	0	
MYSP 2	2	0	0	
POCR3	2	0	0	
PORI	1	0	0	
POAM	1	0	0	
NULU	1	1	0	
TYLA	2	0	0	
POPU 7	1	0	0	
POPE 6	1	0	0	
IRPS	1	0/1	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
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4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
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2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 18 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: AC

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 18

Waterbody Name: Crooked

Bed Size: 0.5

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 8

High Organic? 1

Canopy Abundance at Site: S: 2 N: 1 F: 2 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67539

Longitude: W85.05219

Max. Lakeward Extent of Bed

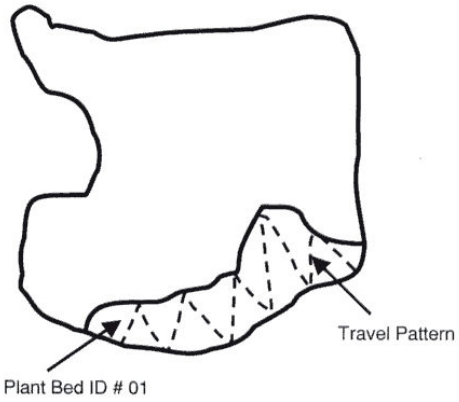
Latitude: N41.67507

Longitude: W85.05176

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
PU20	1	0	0	
POPU7	1	0	0	
POAM	1	0	0	
NYTU	2	0	0	
NULU	3	0	0	
IRVE	1	0	0	
DIAM	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
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2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
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2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 19 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 19

Bed Size: ~~80~~ 3.8

Substrate: 2

Marl? 0

High Organic? 0

Waterbody Name: Crooked

Waterbody ID:

Total # of Species 3

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67305

Longitude: W85.65228

Max. Lakeward Extent of Bed

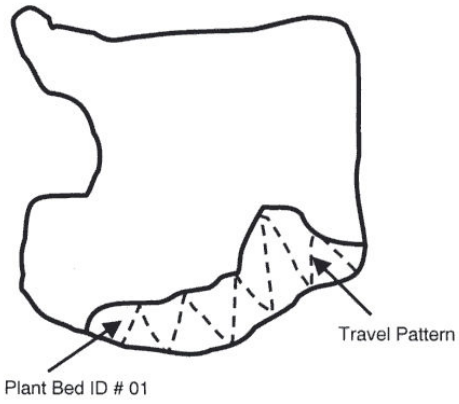
Latitude: N41.67090

Longitude: W85.64989

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POCR3	3	0	0	
MYSP2	3	0	0	
POPU7	1	1	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
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2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

AQUATIC CONTROL

Aquatic Vegetation Plant Bed Data Sheet

Page 20 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: NL7820

Waterbody Name: Crooked

Bed Size: 2.9

Substrate: 02

Waterbody ID:

Marl? 0

Total # of Species 5

High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 3 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67608

Longitude: W85.06859

Max. Lakeward Extent of Bed

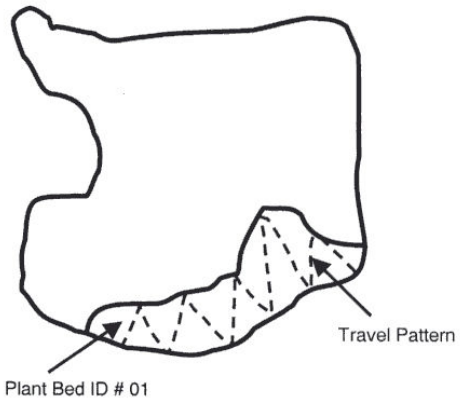
Latitude: N41.67429

Longitude: W85.66845

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	4	0	0	
POCO	1	0	0	
MYSP2	3	0	0	
POCR3	1	0	0	
POAM	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
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2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
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2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 21

Waterbody Name: Crooked

Bed Size: 1.2

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 4

High Organic? 1

CanopyAbundance at Site

S: 4 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67618

Longitude: W85.06899

Max. Lakeward Extent of Bed

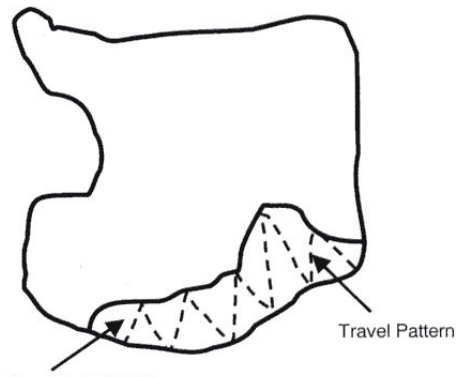
Latitude: N41.67614

Longitude: W85 06914

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	2	0	0	
POAM	1	0	0	
POPU7	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
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2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
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2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 22 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: AC

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 22

Waterbody Name: Crooked

Bed Size: 6.9

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 4

High Organic? 1

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67880

Longitude: W85.07029

Max. Lakeward Extent of Bed

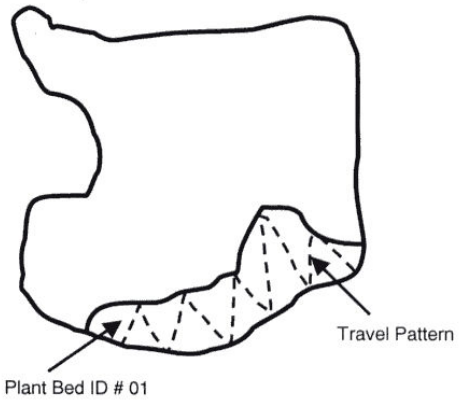
Latitude: N41.67893

Longitude: W85.07057

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POAM	3	0	0	
POCR3	2	0	0	
POPU7	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 23 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 23
Bed Size: 92.4
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 9

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

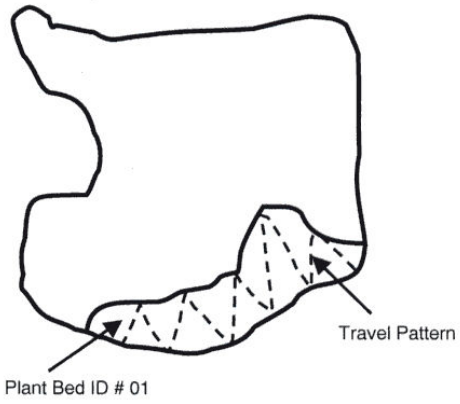
Center of the Bed
Latitude: N41.68399
Longitude: W85.07296

Max. Lakeward Extent of Bed
Latitude:
Longitude:

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	2	0	0	
CEDE4	1	0	0	
POCR3	2	0	0	
POAM	2	0	0	
POPU7	1	0	0	
POPE6	1	0	0	
LEMN	1	2	0	
NYTU	1	0	0	
NULU	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 24 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: AC

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 24
Bed Size: 4.6
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 4

CanopyAbundance at Site

S:	N:	F:	E:
3	1	1	1

SITE COORDINATES

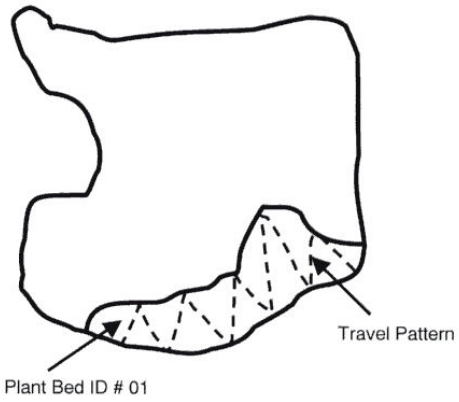
Center of the Bed
Latitude: N41.68511
Longitude: W85.07250

Max. Lakeward Extent of Bed
Latitude: N41.68468
Longitude: W85.07273

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	3	0	0	
POAM	1	0	0	
CEPE4	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

AQUATIC CONTROL

Aquatic Vegetation Plant Bed Data Sheet

Page 25 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 25
Waterbody Name: Crooked
Bed Size: 1.05
Substrate: 2
Waterbody ID:
Marl? 0
Total # of Species 5
High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 3 E: 2

SITE COORDINATES

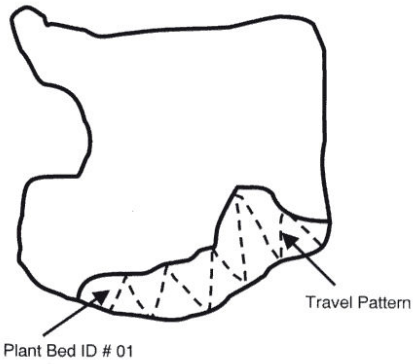
Center of the Bed
Latitude:
Longitude:

Max. Lakeward Extent of Bed
Latitude: N41.68560
Longitude: W85.07382

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
TYLA	3	0	0	
NYTU	3	0	0	
MYSP2	2	0	0	
B.Bush CEOC	1	0	0	
S.Stem SCVA	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
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Abundance:
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2 = 2-20%
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4 = > 60%

QE Code:
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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 26 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: AC

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 26

Waterbody Name: Crooked

Bed Size: 3.8

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 4

High Organic? 1

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.68313

Longitude: W85.07534

Max. Lakeward Extent of Bed

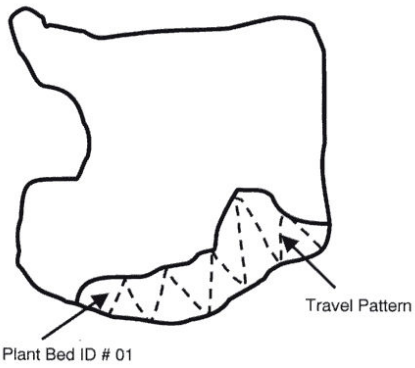
Latitude: N41.68805

Longitude: W85.07577

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2 (Lonydef)	4	0	0	
POAM	3	0	0	
POCR3	2	0	0	
POPW7	1	1	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
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2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 27 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 27
Waterbody Name: Crooked
Bed Size: 7.7
Substrate: 2
Waterbody ID:
Marl? 0
Total # of Species 4
High Organic? 1
CanopyAbundance at Site
S: 4 N: 1 F: 1 E: 1

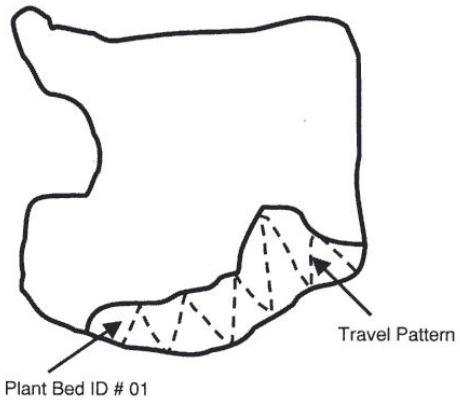
SITE COORDINATES

Center of the Bed
Latitude: N41.69037
Longitude: W85.07842
Max. Lakeward Extent of Bed
Latitude: N41.68914
Longitude: W85.07848

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	2	0	0	
POAM	1	0	0	
NYTU	.1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

AQUATIC CONTROL

Aquatic Vegetation Plant Bed Data Sheet

Page 28 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 28

Waterbody Name: Crooked

Bed Size: 0.2

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 5

High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 4 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.69483

Longitude: W85.08422

Max. Lakeward Extent of Bed

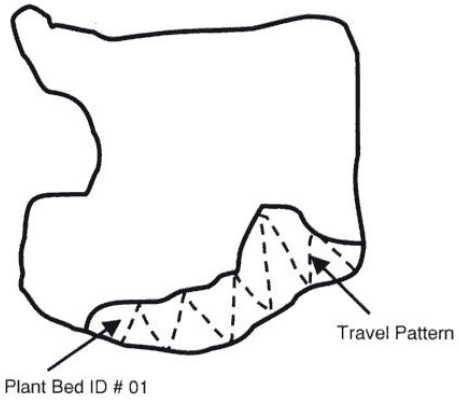
Latitude: N41.69472

Longitude: W85.08416

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	4	0	0	
NULU	1	0	0	
POZO	1	0	0	
POCR3	1	0	0	
MYSP2	2	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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3 = Unknown

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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 29 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: AC

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 29

Bed Size: 10.8

Substrate: 2

Marl? 0

High Organic? 2

Waterbody Name: Crooked

Waterbody ID:

Total # of Species 4

CanopyAbundance at Site

S: 4 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.69258

Longitude: W85.08457

Max. Lakeward Extent of Bed

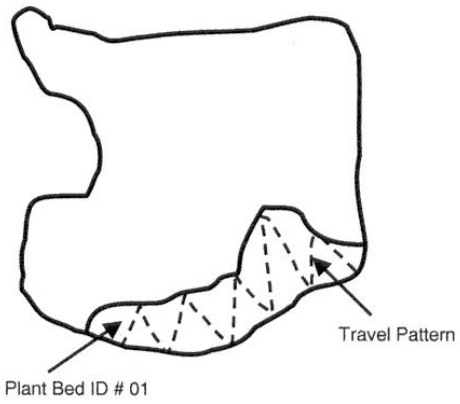
Latitude: N41.69273

Longitude: W85.08434

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	2	0	0	
POPEG	1	0	0	
NYTU	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

AQUATIC CONTROL

Aquatic Vegetation Plant Bed Data Sheet

Page 30 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 30
Waterbody Name: Crooked
Bed Size: 20.0
Substrate: 2
Waterbody ID:
Marl? 0
Total # of Species 10
High Organic? 1

CanopyAbundance at Site

S: 2 N: 1 F: 3 E: 1

SITE COORDINATES

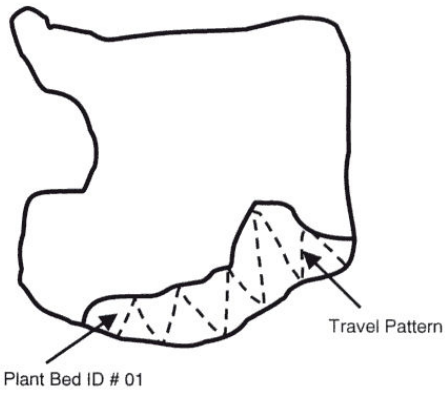
Center of the Bed
Latitude: N41.68511
Longitude: W85.07508

Max. Lakeward Extent of Bed
Latitude: N41.68876
Longitude: W85.07750

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
MYSP2	3	0	0	
POAM	1	0	0	
POCR3	3	0	0	
BRSC	1	0	0	
POPE6	1	0	0	
POPU7	1	1	0	
CHRA	1	2	0	
TYLA	3	1	0	
NULU	2	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 31 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 31
Waterbody Name: Crooked
Bed Size: 6.5
Substrate: 2
Waterbody ID:
Marl? 0
Total # of Species 5
High Organic? 1

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

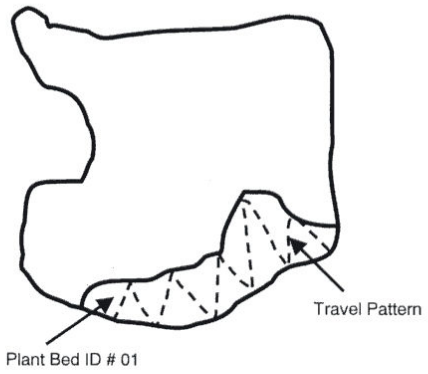
Center of the Bed
Latitude: N41.68597
Longitude: W85.07503

Max. Lakeward Extent of Bed
Latitude: N41.68610
Longitude: W85.07503

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POCR3	3	0	0	
CEDE4	1	0	0	
NYTU	1	0	0	
POPE6	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 32 of 32

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 6-14-06

SITE INFORMATION

Plant Bed ID: 32

Waterbody Name: Crooked

Bed Size: 4.6

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 5

High Organic? 1

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.68095

Longitude: W85.07273

Max. Lakeward Extent of Bed

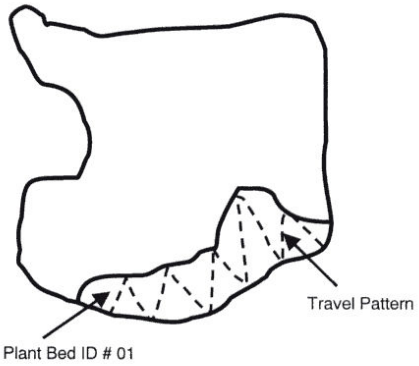
Latitude: N 41.68112

Longitude: W85.07256

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POAM	3	0	0	
POCR3	2	0	0	
POPU7	1	0	0	
NAEC	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
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2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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Voucher:
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2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Tier 1

Aquatic Vegetation Reconnaissance Sampling

Waterbody Cover Sheet

Surveying Organization: Aquatic Control

Waterbody Name: Crooked Lake ID:

County: Sturgeon Date: 8-23-06

Habitat Stratum: 1L Ave. Lake Depth (ft): Lake Level: Norm

GPS Metadata

Crew Leader: N. Long

Datum: NAD27 Zone: 16 Accuracy: 3M

Recorder: M. Johnson Method: D

Secchi Depth (ft): 10.5 Total # of Plant Beds Surveyed: 23 Total # of Species: 30

Littoral Zone Size (acres): 490.8

- ☐ Measured
- ☒ Estimated

Littoral Zone Max. Depth (ft): 16.6

- ☒ Measured
- ☐ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:

Aquatic Vegetation Plant Bed Data Sheet

Page 1 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: Aquatic Control

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 01
Bed Size: 3.3
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 11

CanopyAbundance at Site

S: 1 N: 1 F: 2 E: 1

SITE COORDINATES

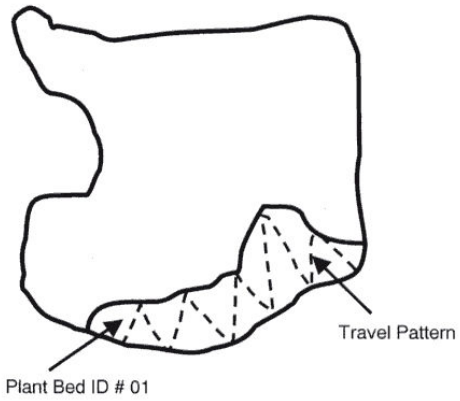
Center of the Bed
Latitude: N41.67080
Longitude: W85.03267

Max. Lakeward Extent of Bed
Latitude: N41.67076
Longitude: W85.03497

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	2	0	0	
NYTU	1	0	0	
LYSA	1	0	0	
DIAM	1	0	0	
TYLA	1	0	0	
WOLF	1	0	0	
LEMI	1	1	0	
MYSP2	2	0	0	
NAFL	2	0	0	
PORI2	2	0	0	
POIL	1	1	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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Voucher:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 2 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: Aquatic Control

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 02

Bed Size: 202.4

Substrate: 6

Marl? 0

High Organic? 0

Waterbody Name: Crooked

Waterbody ID:

Total # of Species 67

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: —

Longitude: —

Max. Lakeward Extent of Bed

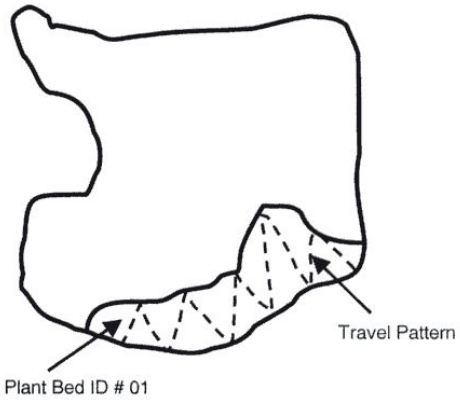
Latitude: N41.67243

Longitude: W85.04514

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CHARA	1	2	0	
PORI2	1	0	0	
POIL	1	1	0	
VAAM3	1	0	0	
NYTU	1	0	0	
MYSP2	1	0	0	
POPE6	1	0	0	

Individual Plant Bed Survey



Comments:

Sparse Veg. Sandy most near shore areas

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
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QE Code:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 3 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: Aquatic Control

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 03

Bed Size: ~~29.8~~ 35.8

Substrate: 3

Marl? 0

High Organic? 0

Waterbody Name: Crooked

Waterbody ID:

Total # of Species 5

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67374

Longitude: W85.03842

Max. Lakeward Extent of Bed

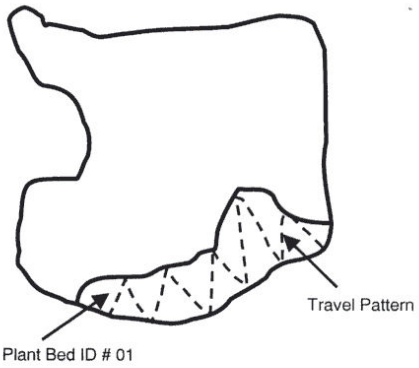
Latitude: N41.67638

Longitude: W85.03916

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	6	
NAFL	1	0	0	
POPE6	1	0	6	
CHARA	1	2	0	
CEDE4	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
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Abundance:
1 = < 2%
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QE Code:
0 = as defined
1 = Species suspe
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3 = Unknown

Voucher:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 4 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: Aquatic Control

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 04
Bed Size: 24.4
Substrate: 3
Marl? 0
High Organic? 0

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 6

CanopyAbundance at Site

S:	N:	F:	E:
1	1	1	1

SITE COORDINATES

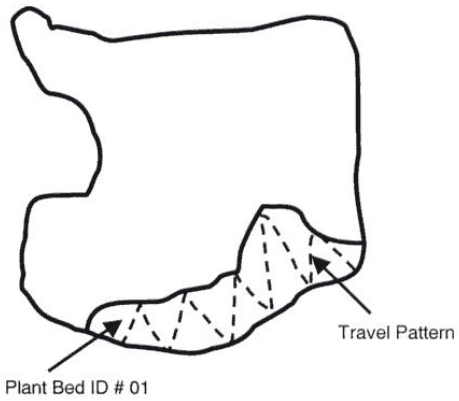
Center of the Bed
Latitude: N41.67687
Longitude: W85.04792

Max. Lakeward Extent of Bed
Latitude: N41.67694
Longitude: W85.04278

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NAFL	3	0	0	
CHARA	2	2	0	
MYSP2	1	0	0	
POPE6	1	0	0	
ELNU	1	1	0	
PORI2	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
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Abundance:
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1 = Taken, not varified
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 5 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 05

Waterbody Name: Crooked

Bed Size: 2.5

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 3

High Organic? 0

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67595

Longitude: W85.04350

Max. Lakeward Extent of Bed

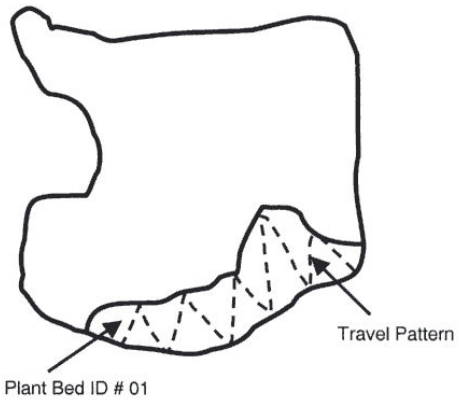
Latitude: N41.67664

Longitude: W85.04252

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POPE6	1	0	0	
CHARA	1	2	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
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Abundance:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 6 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: Aquatic Control

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 06
Bed Size: 2.2
Substrate: 3
Marl? 0
High Organic? 0

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 3

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

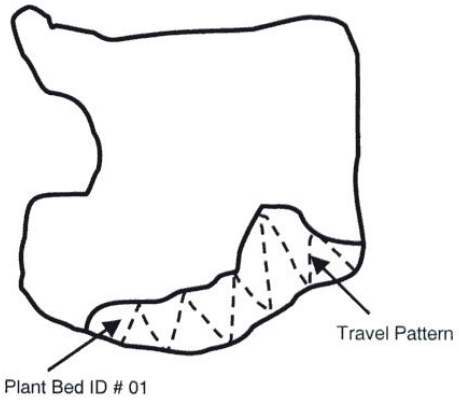
Center of the Bed
Latitude: N41.67481
Longitude: W85.04267

Max. Lakeward Extent of Bed
Latitude: —
Longitude: —

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POPE6	1	0	0	
NYTU	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
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Abundance:
1 = < 2%
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QE Code:
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2 = Genus suspected
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 7 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: A. C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 07
Bed Size: 3.1
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 9

CanopyAbundance at Site

S:	N:	F:	E:
1	1	2	1

SITE COORDINATES

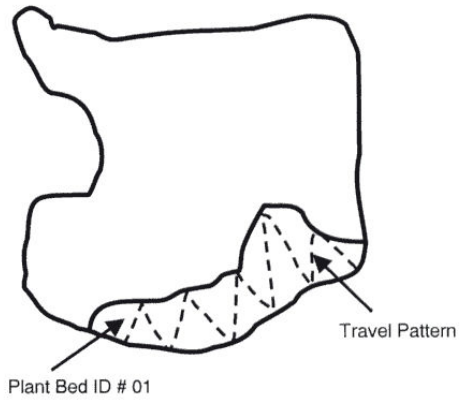
Center of the Bed
Latitude: N41.67365
Longitude: W85.04864

Max. Lakeward Extent of Bed
Latitude: N41.67516
Longitude: W85.04859

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	2	0	0	
POCO	2	0	0	
VAAM3	1	0	0	
CHARA	2	2	0	
BRSC	1	0	0	
NYTU	2	0	0	
TYLA	2	0	0	
MYSP2	1	0	0	
NAFL	2	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 08
Bed Size: 8.2
Substrate: 3
Marl? 0
High Organic? 0

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 4

CanopyAbundance at Site

S:	N:	F:	E:
1	1	1	1

SITE COORDINATES

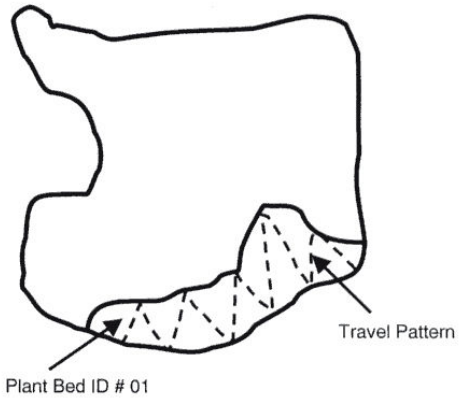
Center of the Bed
Latitude: N41.67367
Longitude: W85.05255

Max. Lakeward Extent of Bed
Latitude: N41.67348
Longitude: W85.05275

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
POAM	1	0	0	
NAFL	1	0	0	
POPU7	1	1	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 09
Bed Size: 0.9
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 7

CanopyAbundance at Site

S: 1 N: 1 F: 3 E: 1

SITE COORDINATES

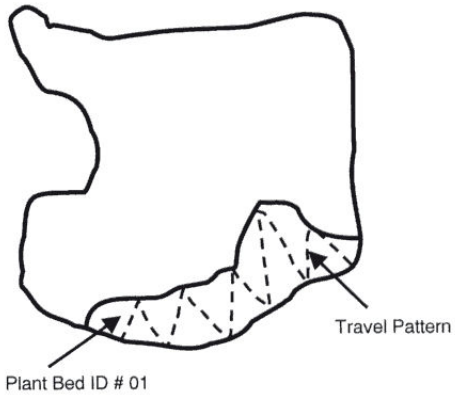
Center of the Bed
Latitude: N41.67541
Longitude: W85.05221

Max. Lakeward Extent of Bed
Latitude: N41.67508
Longitude: W85.05167

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MySP2	2	0	0	
NULU	3	0	0	
NyTa	2	0	0	
CH?RA	1	2	0	
DIAM	1	0	0	
IRVE	1	0	0	
POAM	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A. Control

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 10

Bed Size: 6.5

Substrate: 2

Marl? 0

High Organic? 1

Waterbody Name: Crooked

Waterbody ID:

Total # of Species 8

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67333

Longitude: W85.06520

Max. Lakeward Extent of Bed

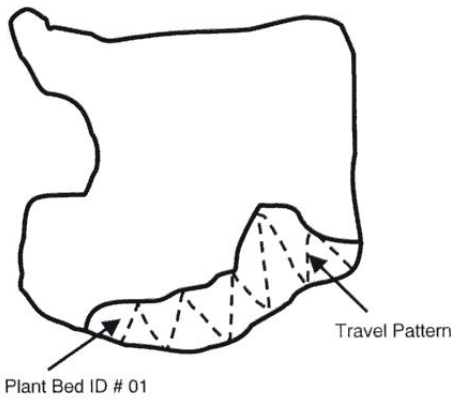
Latitude: N41.67326

Longitude: W85.06411

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
POAM	2	0	0	
MYSP2	1	0	0	
CHARA	2	2	0	
NYTU	1	0	0	
POPE4	2	0	0	
POGR	1	0	0	
POIL	1	0	0	
VAAM3	2	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 11
Bed Size: 4.1
Substrate: 2
Marl? 0
High Organic? 1

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 8

CanopyAbundance at Site

S: 1 N: 1 F: 4 E: 1

SITE COORDINATES

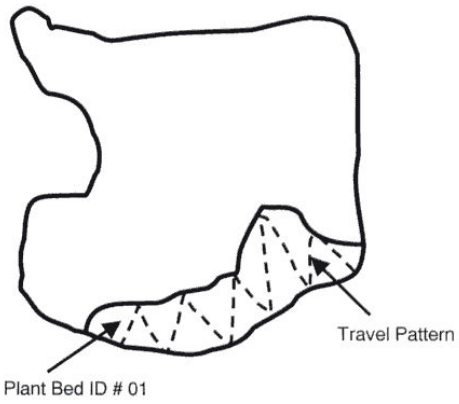
Center of the Bed
Latitude: N41.67286
Longitude: W 85.06645

Max. Lakeward Extent of Bed
Latitude: N41.67329
Longitude: W 85.06564

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
TYLA	2	0	0	
POCO	1	0	0	
NULU	1	0	0	
CHARA	1	2	0	
PORI	1	0	0	
LYSA	1	0	0	
POPEG	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 12

Waterbody Name: Crooked

Bed Size: 4.1

Substrate: 1

Waterbody ID:

Marl? 0

Total # of Species 41

High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 41 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.67666

Longitude: W85.06877

Max. Lakeward Extent of Bed

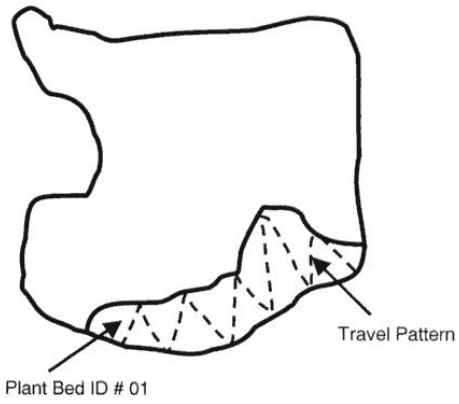
Latitude: N41.67438

Longitude: W85.06845

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NULU	4	0	0	
POCO	1	0	0	
POAM	1	0	0	
MYSP2	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 13
Waterbody Name: Crooked
Bed Size: 10.1
Substrate: 1
Waterbody ID:
Marl? 0
Total # of Species 7
High Organic? 1

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

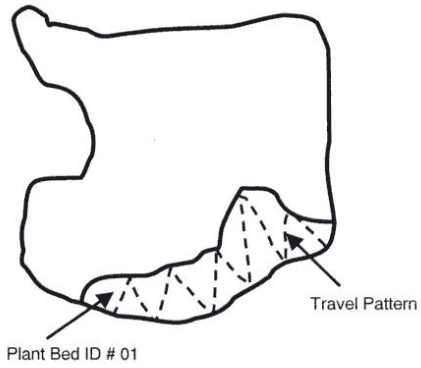
Center of the Bed
Latitude: N41.68028
Longitude: W85.07089

Max. Lakeward Extent of Bed
Latitude: N41.68496
Longitude: W85.07328

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
CHARA	1	2	0	
POPE6	1	0	0	
POGR	1	0	0	
POIL	1	0	0	
POAM	2	0	0	
ZODU	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A. C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 14

Waterbody Name: Crooked

Bed Size: 6.5

Substrate: 1

Waterbody ID:

Marl? 0

Total # of Species 6

High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.68378

Longitude: W85.07101

Max. Lakeward Extent of Bed

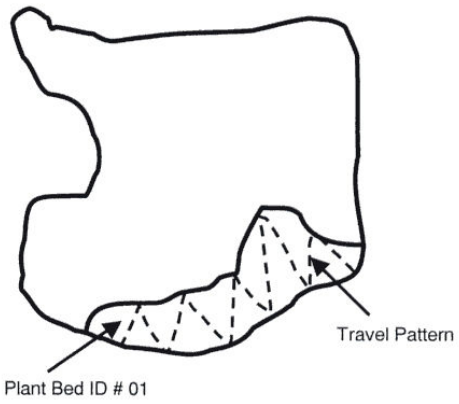
Latitude: N41.68312

Longitude: W85.07104

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	2	0	0	
TYLA	2	0	0	
POPE6	2	0	0	
POAM	1	0	0	
POIL	1	0	0	
POGR	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 15
Waterbody Name: Crooked
Bed Size: 2.2
Substrate: 1
Waterbody ID:
Marl? 0
Total # of Species 3
High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 3 E: 3

SITE COORDINATES

Center of the Bed
Latitude: —
Longitude: —

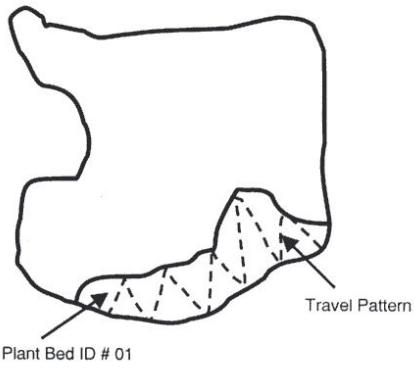
Max. Lakeward Extent of Bed
Latitude: N41.68561
Longitude: W85.07379

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	3	0	0	
TYLA	3	0	0	
SCVA	1	0	0	

A. Bultman

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 16
Bed Size: 80.9
Substrate: 1
Marl? 0
High Organic? 1

Waterbody Name: Crooked
Waterbody ID:
Total # of Species 8

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

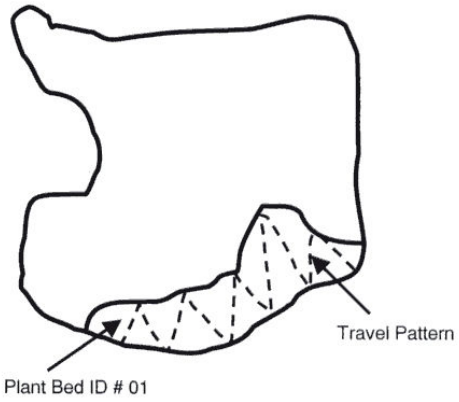
Center of the Bed
Latitude: N41.68427
Longitude: W85.07282

Max. Lakeward Extent of Bed
Latitude:
Longitude:

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MySP2	2	0	0	
CHARA	2	2	0	
POPEG	1	0	0	
NAFL	2	0	0	
POAM	1	0	0	
NyTU	1	0	0	
POIL	1	0	0	
POGR	1	0	0	

Individual Plant Bed Survey



Comments:

Mid Lake scattered Veg.

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 17 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 17

Waterbody Name: Crooked

Bed Size: 4.0

Substrate: 1

Waterbody ID:

Marl? 0

Total # of Species 5

High Organic? 1

CanopyAbundance at Site

S:	N:	F:	E:
1	1	1	1

SITE COORDINATES

Center of the Bed

Latitude: N41.69264

Longitude: W85.08121

Max. Lakeward Extent of Bed

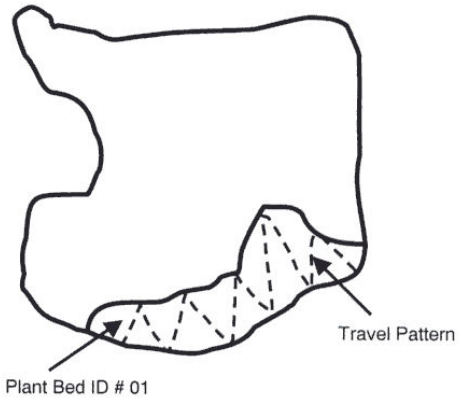
Latitude: N41.69196

Longitude: W85.08138

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CHARA	3	2	0	
POAM	2	0	0	
POGR	2	0	0	
POIL	1	0	0	
MYSP2	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

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State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 18
Waterbody Name: Crooked
Bed Size: 42.5
Substrate: 1
Waterbody ID:
Marl? 0
Total # of Species 7
High Organic? 1

CanopyAbundance at Site

S: 3 N: 1 F: 1 E: 1

SITE COORDINATES

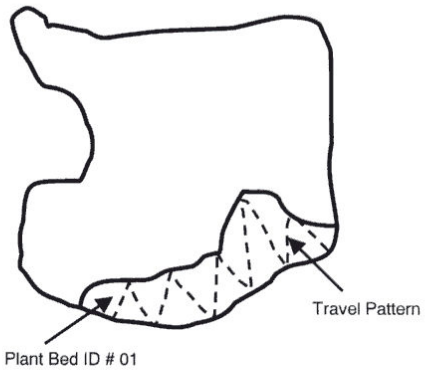
Center of the Bed
Latitude: N41.68887
Longitude: W85.07756

Max. Lakeward Extent of Bed
Latitude: N41.68168
Longitude: W85.07247

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
NAFL	2	0	0	
CHARA	2	2	0	
UTVA	1	1	0	
POGR	1	0	0	
POIL	1	0	0	
POAM	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 19 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 19
Waterbody Name: Crooked
Bed Size: 20.9
Substrate: 1
Waterbody ID:
Marl? 0
Total # of Species 7
High Organic? 1

CanopyAbundance at Site

S: 1 N: 1 F: 4 E: 2

SITE COORDINATES

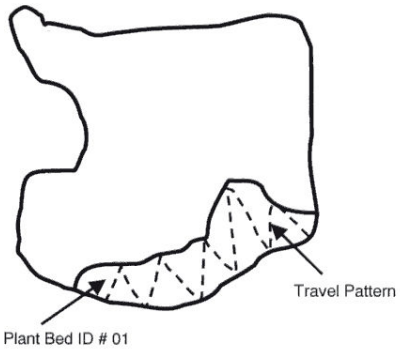
Center of the Bed
Latitude: N41.68545
Longitude: W85.07549

Max. Lakeward Extent of Bed
Latitude: N41.68445
Longitude: W85.07391

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
NYTU	4	0	0	
NULU	2	0	0	
BRSC	1	0	0	
TYLA	2	0	0	
MYSP2	1	0	0	
CHARA	1	2	0	
POAM	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
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2 = Genus suspected
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 20 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 20
Bed Size: 1.3
Substrate: 2
Marl? 0
High Organic? 0

Waterbody Name: Crooked Lake
Waterbody ID:
Total # of Species 4

CanopyAbundance at Site

S:	N:	F:	E:
1	1	1	1

SITE COORDINATES

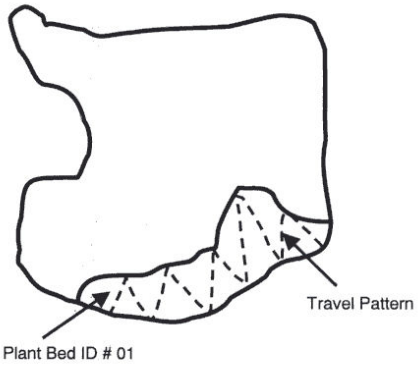
Center of the Bed
Latitude: N41.66996
Longitude: W85.05248

Max. Lakeward Extent of Bed
Latitude: N41.67013
Longitude: W85.05196

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
CHARA	1	2	0	
NAFL	1	0	0	
NAMI	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
0 = as defined
1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
0 = Not Taken
1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 21 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 21

Waterbody Name: Crooked

Bed Size: 3.5

Substrate: 2

Waterbody ID:

Marl? 0

Total # of Species 5

High Organic? 0

CanopyAbundance at Site

S: 1 N: 1 F: 1 E: 1

SITE COORDINATES

Center of the Bed

Latitude: N41.66344

Longitude: W85.04096

Max. Lakeward Extent of Bed

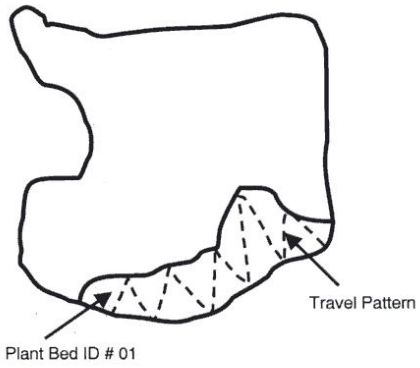
Latitude: N41.66889

Longitude: W85.04076

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
CHARA	2	2	0	
NAFL	3	0	0	
POFO	1	0	0	
MYSP2	1	0	0	
POGR	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
1 = Silt/Clay
2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
1 = Present
0 = absent

High Organic
1 = Present
0 = absent

Overall Surface Cover
N = Nonrooted floating
F = Floating, rooted
E = Emergent
S = Submersed

Canopy:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

Abundance:
1 = < 2%
2 = 2-20%
3 = 21-60%
4 = > 60%

QE Code:
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1 = Species suspe
2 = Genus suspected
3 = Unknown

Voucher:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 22 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: A.C.

DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 22
Bed Size: 3.1
Substrate: 2
Marl? 0
High Organic? 1
Waterbody Name: Crooked
Waterbody ID:
Total # of Species 6

CanopyAbundance at Site

S: 1 N: 1 F: 2 E: 1

SITE COORDINATES

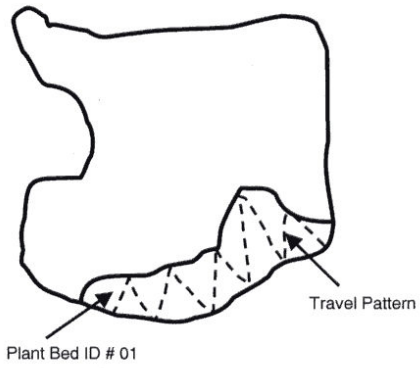
Center of the Bed
Latitude: N41.46672
Longitude: W85.03788

Max. Lakeward Extent of Bed
Latitude: N41.46739
Longitude: W85.03912

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
TYLA	2	0	0	
NUCA	2	0	0	
NYTU	2	0	0	
MYSP2	1	0	0	
NAFL	1	0	0	
PORI	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
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2 = Silt w/Sand
3 = Sand w/Silt
4 = Hard Clay
5 = Gravel/Rock
6 = Sand

Marl
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0 = absent

High Organic
1 = Present
0 = absent

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N = Nonrooted floating
F = Floating, rooted
E = Emergent
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Abundance:
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1 = Taken, not varified
2 = Taken, varifie

Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Plant Bed Data Sheet

Page 23 of 23

State of Indiana Department of Natural Resources

ORGANIZATION: A.C. DATE: 8-23-06

SITE INFORMATION

Plant Bed ID: 2033 NL
Waterbody Name: Crooked
Bed Size: 18.3
Substrate: 3
Waterbody ID:
Marl? 0
Total # of Species 5
High Organic? 0

CanopyAbundance at Site

S: 2 N: 1 F: 1 E: 1

SITE COORDINATES

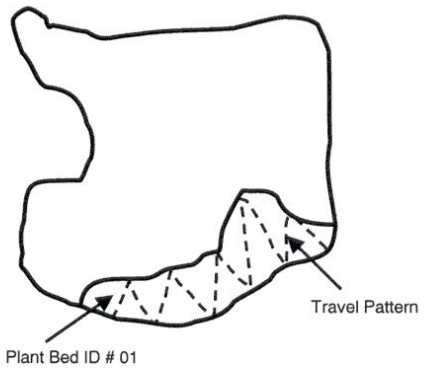
Center of the Bed
Latitude: N41.66846
Longitude: W85.03728

Max. Lakeward Extent of Bed
Latitude: N41.66880
Longitude: W85.03886

SPECIES INFORMATION

Species Code	Abundance	QE	Vchr.	Ref. ID
MYSP2	4	0	0	
NAFL	2	0	0	
CEDE4	2	0	0	
2ODU	1	0	0	
ELCA7	1	0	0	

Individual Plant Bed Survey



Comments:

REMINDER INFORMATION

Substrate:
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5 = Gravel/Rock
6 = Sand

Marl
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High Organic
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Abundance:
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Reference ID:
Unique number or letter to denote specific location of a species; referenced on attached map

Aquatic Vegetation Random Sampling

Waterbody Cover Sheet

Organization Name: Aquatic Control

Waterbody Name: Crooked Lake ID:

County: Steuben Date: 8-23-06

Habitat Stratum: 12 Ave. Lake Depth (ft): Lake Level: Normal

GPS Metadata

Crew Leader: N. Lung Datum: Nad27 Zone: 16 Accuracy: 3M

Recorder: M. Johnson Method: D

Secchi Depth (ft): 10.5 Total # of Sites Surveyed: 100 Total # of Species: 18

Littoral Zone Size (acres): 490.8

- ☐ Measured
- ☒ Estimated

Littoral Zone Max. Depth (ft): 16.0

- ☒ Measured
- ☐ Estimate (historical Secchi)
- ☐ Estimated (current Secchi)

Notable Conditions:

APPENDIX A

Submersed Aquatic Plant Survey Form

Page 1 of 4

WATER BODY NAME	Crooked				SECCHI	12.5								
COUNTY	Stuelen				MAX PLANT DEPTH									
DATE	8-23-06				WEATHER									
CREW LEADER	NL				COMMENTS									
RECORDER	M; J													
					Rake score (1-5), observed only (9), algae present (p)									
					Use acronyms for species, V1, V2...for voucher codes									Note
									Species Code					
					COON	milf	Eel	C. Rind	Rich	Chara	SASO	very	leafy	
Site	Northing	Easting	Depth	All	CEDE4	MYSP2	VAAM5	NAFL	PORT	CHZSA	POPEL	POGR	POFO	ELNU1
1			12	5		5		1		1				
2			16	1		1								
3			8	5		1		5						
4			6	1		1		1		1				
5			20	1						1				
6			10	5	3	5		3			1			
7			12	5	1	5		1						
8			14	5		5		1						
9			12	5		5								
10			12	5	1	5		1						
11			13	3		3								
12			11	NP										
13			13	NP										
14			5	NP										
15			7	5		1		3		5				
16			6	5		1		5				1		POLL-1
17			16	1		1								
18			6	5		1		3		3				
19			4	3				3				1	1	
20			3	NP										
21			4	NP										
22			18	NP										
23			7	1				1						
24			6	5	1			5		3				
25			7	5		1		5		1			1	
26			9	1		1		1			1			1
27			16	NP										
28			11	1		1								
29			8	1		1								
30			9	5		5								
31			7	NP										
32			8	5		1		5						POAM 1
Other plant species observed at lake														

APPENDIX A

Submersed Aquatic Plant Survey Form

Page 2 of 4

WATER BODY NAME: Crooked
COUNTY: Steuben
DATE: 8-23-06 + 24
CREW LEADER: NL
RECORDER: MIJ
SECCHI:
MAX PLANT DEPTH:
WEATHER:
COMMENTS:

Rake score (1-5), observed only (9), algae present (p)
Use acronyms for species, V1, V2...for voucher codes

	Site	Northing	Easting	Depth	All	CEVE (Coon)	MYSP (Milfoil)	NAFL (Naiad)	CHARA (Chara)	POPE (Sago)	POGR (Variable)	POPU7 (Small)	POAM (Large)	EAAJ (Eel)	Note MYHE (~~MYSP~~ ~~POGR~~)	
	33			11	5		5	3	1							
	34			11	1			1	1	1						
	35			7	1			1			1					
	36			15	NP											
	37			5	1			1				1				
	38			18	NP											
	39			4	5		1		1	1	1		3	1	[illegible]	POIL-1
P	40			4	5		3	1	1						1	UTVA 1
	41			5	1								1			UTLA 1
	42			5	1		1		1				1		1	
	43			7	3		1		1				1			
	44			5	5		3		1				1			
	45			8	1		1									
3-1	46			6	5		3									ZODU 1
	47			6	3		3									
	48			6	5		3		3							
	49			3	5				5	1						
	50			5	5		1		3		1					
	51			5	3		3		1							UTVA 1
P	52			7	NP											
	53			4	5		5	1			1		1			
	54			3	5		1		5		1		1			POIL-1
	55			5	5		3		1		1					
	56			4	5		1	3	5							
	57			3	5		5									
	58			7	5		5									
	59			5	5		5		1							
P	60			5	3		3									
P	61			6	1		1									
P	62			4	1		1									
	63			5	3		3		1							
	64			5	5		5									

Other plant species observed at lake: NULU, NYTU, TxA, ZODU

Pick weed

APPENDIX A

Submersed Aquatic Plant Survey Form

Page ____ of ____

WATER BODY NAME						SECCHI										
COUNTY						MAX PLANT DEPTH										
DATE 8/21-06						WEATHER										
CREW LEADER						COMMENTS										
RECORDER																
						Rake score (1-5), observed only (9), algae present (p)										
						Use acronyms for species, V1, V2…for voucher codes										Note
						Coon	Milf	Naid	Chara	Species Code						
Site	Northing	Easting	Depth	All		CEVE4	MYSP2	NAFL	CHRA	POPE8	POGR	POAM	UTVA	NAMI3	POFO	
65			5	1		1	1	1				1				
66			5	3		3										
67			4	3					3							
68			4	NP												
69			5	NP												
76			2	1	1	1					1					
71			5	1			1									
72			11	NP												
73			16	NP												
74			13	1			1									
75			18	NP												
76			15	NP												
77			16	NP												
78			9	5		3	3							1		
79			11	1				1								
80			12	NP												
81			12	1		1										
82			8	3			3									
83			14	NP												
84			11	NP												
85			11	5		1	5							1		
86			6	1			1				1					POIL·1
87			17	1		1		1							1	
88			8	5			1	5								
89			6	5			3	3								
90			4	3	1	1	3									
91			5	5	3	5										[redacted] 201
92			7	5		5	3									ELOD·1
93			4	1			1									
94			3	5	1	1	1									PORT·3
95			11	5		5	1									ZODU·1
96			15	1		1										
Other plant species observed at lake																

APPENDIX A

Submersed Aquatic Plant Survey Form

Page 4 of ____

WATER BODY NAME	Crooked				SECCHI									
COUNTY	PT	8-24-06			MAX PLANT DEPTH									
DATE	Stauber				WEATHER									
CREW LEADER	NS				COMMENTS									
RECORDER	AJ													
					Rake score (1-5), observed only (9), algae present (p)									
					Use acronyms for species, V1, V2...for voucher codes									Note
					MYSP2	NAFL	CEOF4	NAMI	POIL	Species Code				
Site	Northing	Easting	Depth	All										
97			12	5	5	1	1							
98			14	5	3	3	3							
99			15	NP										
100			10	5	3	1		3	1					
Other plant species observed at lake														

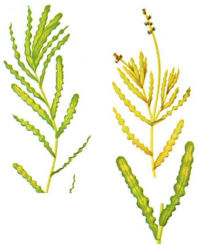
Lake	Date	Latitude	Longitude	Design	Site	Depth	RAKE	MYSP2	POCR3	CEDE4	CH?AR	NAMI	NAFL	POPE6	POPU7	VAAM3	ELCA7	POFO3	PORI2	POAM	POGR8	MYHE	ZODU	ELNU2	POIL	UTMA
Crooked Lake	8/23/06	41.66949	-85.037534		1	12.0	5	5			1		1													
Crooked Lake	8/23/06	41.67054	-85.039176		2	16.0	1	1																		
Crooked Lake	8/23/06	41.67098	-85.041236		3	8.0	5	1					5													
Crooked Lake	8/23/06	41.67197	-85.042999		4	6.0	1	1			2		1													
Crooked Lake	8/23/06	41.6737	-85.041262		5	20.0	1				2															
Crooked Lake	8/23/06	41.67375	-85.039895		6	10.0	5	5		3			3	1												
Crooked Lake	8/23/06	41.67449	-85.038336		7	12.0	5	5		1			1													
Crooked Lake	8/23/06	41.67204	-85.036361		8	14.0	5	5					1													
Crooked Lake	8/23/06	41.67349	-85.034848		9	12.0	5	5																		
Crooked Lake	8/23/06	41.67509	-85.034485		10	12.0	5	5		1			1													
Crooked Lake	8/23/06	41.67677	-85.034856		11	13.0	3	3																		
Crooked Lake	8/23/06	41.67875	-85.036289		12	11.0	0																			
Crooked Lake	8/23/06	41.6786	-85.037997		13	13.0	0																			
Crooked Lake	8/23/06	41.67842	-85.040259		14	5.0	0																			
Crooked Lake	8/23/06	41.6788	-85.042654		15	7.0	5	1			5		3													
Crooked Lake	8/23/06	41.67936	-85.044353		16	6.0	5	1					5									1			1	
Crooked Lake	8/23/06	41.67916	-85.047047		17	16.0	1	1																		
Crooked Lake	8/23/06	41.67772	-85.047645		18	6.0	5	1			3		3													
Crooked Lake	8/23/06	41.67629	-85.048436		19	4.0	3						3					1				1				
Crooked Lake	8/23/06	41.67588	-85.046444		20	3.0	0																			
Crooked Lake	8/23/06	41.67667	-85.044432		21	4.0	0																			
Crooked Lake	8/23/06	41.67719	-85.042857		22	18.0	0																			
Crooked Lake	8/23/06	41.67484	-85.04541		23	7.0	1						1													
Crooked Lake	8/23/06	41.67339	-85.046658		24	6.0	5			1	3		5													
Crooked Lake	8/23/06	41.6719	-85.046962		25	7.0	5	1			1		5					1								
Crooked Lake	8/23/06	41.67058	-85.045529		26	9.0	1	1					1	1											1	
Crooked Lake	8/23/06	41.66938	-85.043287		27	16.0	0																			
Crooked Lake	8/23/06	41.67071	-85.048019		28	11.0	1	1																		
Crooked Lake	8/23/06	41.67156	-85.05035		29	8.0	1	1																		
Crooked Lake	8/23/06	41.67247	-85.051787		30	9.0	5	5																		
Crooked Lake	8/23/06	41.67407	-85.052495		31	7.0	0																			
Crooked Lake	8/23/06	41.67506	-85.053924		32	8.0	5	1					5								1					
Crooked Lake	8/23/06	41.67526	-85.056273		33	11.0	5	5			1		3													
Crooked Lake	8/23/06	41.67633	-85.057841		34	11.0	1				1		1	1												
Crooked Lake	8/23/06	41.6762	-85.059457		35	7.0	1						1									1				
Crooked Lake	8/23/06	41.6757	-85.062238		36	15.0	0																			
Crooked Lake	8/23/06	41.6748	-85.063327		37	5.0	1						1		1											
Crooked Lake	8/23/06	41.67359	-85.062943		38	18.0	0																			
Crooked Lake	8/23/06	41.67334	-85.066096		39	4.0	5	1			1			1		1					3	1			1	
Crooked Lake	8/23/06	41.67361	-85.06786		40	4.0	5	3			1		1										1			1
Crooked Lake	8/23/06	41.67517	-85.068762		41	5.0	1														1					1
Crooked Lake	8/23/06	41.67663	-85.06922		42	5.0	1	1			1										1		1			
Crooked Lake	8/23/06	41.67803	-85.070319		43	7.0	3	1			1										1					
Crooked Lake	8/23/06	41.67946	-85.070633		44	5.0	5	3			1										1					
Crooked Lake	8/23/06	41.68069	-85.071396		45	8.0	1	1																		
Crooked Lake	8/23/06	41.68227	-85.071143		46	6.0	5	3	1															1		
Crooked Lake	8/23/06	41.68421	-85.071459		47	6.0	3	3																		
Crooked Lake	8/23/06	41.68501	-85.073278		48	6.0	5	3				3														
Crooked Lake	8/23/06	41.68677	-85.074573		49	3.0	5					5		1												
Crooked Lake	8/23/06	41.68845	-85.07543		50	5.0	5	1				3										1				
Crooked Lake	8/23/06	41.68986	-85.076959		51	5.0	3	3				1														1
Crooked Lake	8/23/06	41.68993	-85.078502		52	7.0	0																			
Crooked Lake	8/23/06	41.69109	-85.080567		53	4.0	5	5					1								1	1				
Crooked Lake	8/23/06	41.69249	-85.08118		54	3.0	5	1				5									1	1			1	
Crooked Lake	8/23/06	41.69297	-85.082579		55	5.0	5	3				1										1				
Crooked Lake	8/23/06	41.6942	-85.082754		56	4.0	5	1				5		3												
Crooked Lake	8/23/06	41.69482	-85.084349		57	3.0	5	5																		
Crooked Lake	8/23/06	41.69338	-85.084623		58	7.0	5	5																		
Crooked Lake	8/23/06	41.69192	-85.0841		59	5.0	5	5				1														
Crooked Lake	8/23/06	41.69059	-85.082435		60	5.0	3	3																		
Crooked Lake	8/23/06	41.68913	-85.08008		61	6.0	1	1																		
Crooked Lake	8/23/06	41.6889	-85.077703		62	4.0	1	1																		
Crooked Lake	8/23/06	41.68732	-85.07628		63	5.0	3	3				1														
Crooked Lake	8/23/06	41.68572	-85.074966		64	5.0	5	5																		
Crooked Lake	8/23/06	41.68321	-85.073379		65	5.0	1	1				1		1												1
Crooked Lake	8/23/06	41.68187	-85.072698		66	5.0	3	3																		
Crooked Lake	8/23/06	41.67922	-85.072009		67	4.0	3					3														
Crooked Lake	8/23/06	41.67776	-85.071784		68	4.0	0																			
Crooked Lake	8/23/06	41.6765	-85.070824		69	5.0	0																			
Crooked Lake	8/23/06	41.67282	-85.067943		70	2.0	1	1		1												1				
Crooked Lake	8/23/06	41.67252	-85.063297		71	5.0	1						1													
Crooked Lake	8/23/06	41.67227	-85.061199		72	11.0	0																			
Crooked Lake	8/23/06	41.67059	-85.061274		73	16.0	0																			
Crooked Lake	8/23/06	41.67042	-85.059524		74	13.0	1						1													
Crooked Lake	8/23/06	41.67038	-85.0579		75	18.0	0																			
Crooked Lake	8/23/06	41.66992	-85.056205		76	15.0	0																			
Crooked Lake	8/23/06	41.66998	-85.054854		77	16.0	0																			
Crooked Lake	8/23/06	41.66985	-85.053402		78	9.0	5	3				1	3													
Crooked Lake	8/23/06	41.67004	-85.051998		79	11.0	1				1															
Crooked Lake	8/23/06	41.67009	-85.050625		80	12.0	0																			
Crooked Lake	8/23/06	41.66919	-85.049933		81	12.0	1	1																		
Crooked Lake	8/23/06	41.66898	-85.048208		82	8.0	3						3													
Crooked Lake	8/23/06	41.66789	-85.04763		83	14.0	0																			
Crooked Lake	8/23/06	41.6674	-85.046354		84	11.0	0																			
Crooked Lake	8/23/06	41.66758	-85.044645		85	11.0	5	1				1	5													
Crooked Lake	8/23/06	41.6681	-85.042877		86	6.0	1						1									1			1	
Crooked Lake	8/23/06	41.66832	-85.041936		87	17.0	1	1				1						1								
Crooked Lake	8/23/06	41.66832	-85.040615		88	8.0	5					5	1													
Crooked Lake	8/23/06	41.66759	-85.039431		89	6.0	5					3	3													
Crooked Lake	8/23/06	41.66688	-85.038379		90	4.0	3	1		1			3													
Crooked Lake	8/23/06	41.66752	-85.037112		91	5.0	5	5		3							1							1		
Crooked Lake	8/23/06	41.66859	-85.036618		92	7.0	5	5					3													
Crooked Lake	8/23/06	41.66959	-85.035914		93	4.0	1						1													
Crooked Lake	8/23/06	41.67072	-85.035252		94	3.0	5	1		1			1							3						
Crooked Lake	8/23/06	41.67037	-85.037966		95	11.0	5	5					1											1		
Crooked Lake	8/23/06	41.673	-85.042724		96	15.0	1	1																		
Crooked Lake	8/23/06	41.67565	-85.039957		97	12.0	5	5		1			1													
Crooked Lake	8/23/06	41.67598	-85.039335		98	14.0	5	3		3			3													
Crooked Lake	8/23/06	41.67754	-85.036195		99	15.0	0																			
Crooked Lake	8/23/06	41.67612	-85.034471		100	10.0	5	3				3	1												1	

16.2 Species List. Macrophyte List for the Crooked Lake

Common Name	Scientific Name	2006 Tier I	2006 Tier II
American elodea	*Elodea canadensis*	X	X
Blueflag Iris	*Iris versicolor*	X	
Brittle naiad	*Najas gracillima*	X	X
Button Bush	*Cephalanthus occidentalis*	X	
Chara	*Chara spp.*	X	X
Common Bladderwort	*Utricularia vulgaris*	X	X
Common cattail	*Typhia latifolia*	X	
Common coontail	*Ceratophyllum demersum*	X	X
Curlyleaf pondweed	*Potamogeton crispus*	X	X
Duckweed	*Lemna minor*	X	
Eel grass	*Valisneria Americana*	X	X
Eurasian watermilfoil	*Myriophyllum spicatum*	X	X
Flatstem pondweed	*Potamogeton zosteriformis*	X	
Horned pondweed	*Zannichellia palustris*	X	
Illinois pondweed	*Potamogeton illinoensis*	X	X
Largeleaf pondweed	*Potamogeton amplifolius*	X	X
Leafy pondweed	*Potamogeton foliosus*	X	X
Pickerel weed	*Pontederia cordata*	X	
Purple loosestrife	*Lythrum salicaria*	X	
Richardson's pondweed	*Potamogeton richardsonii*	X	X
Sago pondweed	*Potomogeton pectinatus*	X	X
Slender elodea	*Elodea nuttallii*	X	X
Slender naiad	*Najas flexilis*	X	X
Small pondweed	*Potamageton pusillus*	X	X
Soft-stem bulrush	*Scirpus validus*	X	
Spatterdock	*Nuphar advena*	X	
Variable pondweed	*Potamogeton gramineus*	X	X
Water stargrass	*Zosterella dubia*	X	X
Watermeal	*Wolfia columiana*	X	
Watershield	*Brasenia schreberi*	X	
White water buttercup	*Ranunculus longirostris*	X	
White water lily	*Nymphaea odorata*	X	
Variable watermilfoil	*Myriophyllum heterophyllum*		X
Yellowflag iris	*Iris pseudacorus*	X	

Chara (*chara spp.)* is an anchored green algae with whorled, branchlike filaments at the nodes of a central axis. Often times mistaken for vascular plants. Typically inhabits shallow water. Provide food and cover for wildlife. Rarely reaches the surface of the water and rarely causes problem.

Common coontail (*Ceratophylum demersum*) is a commonly occurring aquatic plant in the Midwest in neutral to alkaline waters[1]. It is a submersed dicot with coarsely toothed leaves whorled about the stem[2]. This plant is given its name due to its resemblance to the tail of a raccoon. Coontail has been found to be an important food source for wildfowl as well as a good shelter for small animals[2]. This plant is also a good shelter for young fish, and support of insects[2], but has been known to crowd out other species of aquatic plants[3].



Curlyleaf pondweed (*Potamogeton crispus*) is a submersed monocot with slightly clasping, rounded tip leaves. The flowers occur on dense cylindrical spikes and produces distinctive beaked fruit[1]. Curly leaf is eaten by ducks, but may become a weed[2]. This plant provides good food, shelter, and shade for fish and is important for early spawning fish like carp and goldfish[2].

Eurasian watermilfoil (*Myriophyllum spicatum*) is an exotic aquatic plant that has been known to crowd out native species of plants. This species spreads quickly because it can grow from very small plant fragments and survive in low light and nutrient conditions[3]. This dicot has stems that typically grow to the water surface and branch out forming a canopy that shades other species of aquatic plants. Eurasian water-milfoil has characteristic red to pink flowering spikes that protrude from the water surface one to two inches high[1]. The segmented leaves grow in whorls of three to four around the stem[1]. grow from very small plant fragments and survive in low light and nutrient conditions[4]. This dicot has stems that typically grow to the water surface and branch out forming a canopy that shades other species of aquatic plants. Eurasian water-milfoil has characteristic red to pink flowering spikes that protrude from the water

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[1] Chadde, S. 1998. Great lakes wetland flora. Pocketflora Press, Calumet, Michigan.

[2] Fassett, N. 1957. A manual of aquatic plants, 2nd edition. The University of Wisconsin Press, Madison, Wisconsin.

[3]Applied Biocehmists, 1998. Water weeds and algae, 5th edition. Applied Biochemists, J. C. Schmidt and J. R. Kannenberg, editors. Milwaukee, Wisconsin. (all plant illustrations supplied by Applied Biochemist)

surface one to two inches high[1]. The segmented leaves grow in whorls of three to four around the stem[1]. This exotic plant is easily differentiated from its native relative, northern milfoil, by stem growth and the numbers of sections per leaf.

Sago pondweed (*Potamogeton pectinatus*) is a submersed monocot with leaves that are threadlike to narrowly linear that form a sheath around the stem[1]. The nutlet and tubers of this plant make it the most important pondweed for ducks[2]. It also provides food and shelter for young trout and other fish[2]. This species can produce thick nuisance growth in shallow near-shore areas of lakes.

Spatterdock (*Nuphar spp.*) is an emergent dicot with broad, deeply lobed leaves emerging from the water[1]. This plant has distinctive large yellow flowers emanating from spikes. Spatterdock produces seeds and rootstocks that are used by wildfowl, beaver, moose and porcupine[2]. This plant attracts wildfowl and marsh birds and the bases of the petioles are eaten by muskrats[2]. Spatterdock is a poor producer of food for fish, but provides good shade and shelter[2].

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[1] Chadde, S. 1998. Great lakes wetland flora. Pocketflora Press, Calumet, Michigan.

[2] Fassett, N. 1957. A manual of aquatic plants, 2nd edition. The University of Wisconsin Press, Madison, Wisconsin.

[3]Applied Biocehmists, 1998. Water weeds and algae, 5th edition. Applied Biochemists, J. C. Schmidt and J. R. Kannenberg, editors. Milwaukee, Wisconsin. (all plant illustrations supplied by Applied Biochemist)

16.3 IDNR VEGETATION PERMIT

APPLICATION FOR AQUATIC VEGETATION CONTROL PERMIT
State Form 26727 (R / 11-03)
Approved State Board of Accounts 1987
☐ Whole Lake ☒ Multiple Treatment Areas
Check type of permit

INSTRUCTIONS: Please print or type information

FOR OFFICE USE ONLY
License No.
Date Issued
Lake County

Return to: Page 1 of 3
DEPARTMENT OF NATURAL RESOURCES
Division of Fish and Wildlife
Commercial License Clerk
402 West Washington Street, Room W273
Indianapolis, IN 46204

FEE: $5.00

Applicant's Name	Lake Assoc. Name	
Crooked Lake Association	Crooked Lake Association	
Rural Route or Street: 801 West Coliseum Blvd.		Phone Number: 260-482-7665
City and State: Fort Wayne, IN		ZIP Code: 46808
Certified Applicator (if applicable)	Company or Inc. Name	Certification Number
Rural Route or Street		Phone Number
City and State		ZIP Code

Lake (One application per lake)	Nearest Town	County
Crooked Lake	Angola	Stueben
Does water flow into a water supply		☐ Yes ☒ No

Please complete one section for *EACH* treatment area. Attach lake map showing treatment area and denote location of any water supply intake.

Treatment Area # 1	LAT/LONG or UTM's 1st and 2nd basin (Areas to be determined following spring survey)		
Total acres to be controlled <75	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)	
Maximum Depth of Treatment (ft) 12	Expected date(s) of treatment(s) mid to late May		

Treatment method: ☒ Chemical ☐ Physical ☐ Biological Control ☐ Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Eurasian watermilfoil spot treated with Renovate or 2,4-D herbicide in first and second basin

Plant survey method: ☒ Rake ☐ Visual ☐ Other (specify) Data collected during 2006 spring T-1 survey

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian Watermilfoil	X	40
Curlyleaf pondweed		20
Chara		10
Coontail		5
Variable pondweed		5
Largeleaf pondweed		5
sago pondweed		5
Illinois pondweed		5
Slender naiad		1
Richardsons pondweed		1
small pondweed		1
variable watermilfoil		1
American elodea		1

Page 2 of 3

Treatment Area # 2	LAT/LONG or UTM's third basin whole basin sonar treatment	
Total acres to be controlled 184	Proposed shoreline treatment length (ft)	Perpendicular distance from shoreline (ft)
Maximum Depth of Treatment (ft)	Expected date(s) of treatment(s) mid May to early June	

Treatment method: [x] Chemical [ ] Physical [ ] Biological Control [ ] Mechanical

Based on treatment method, describe chemical used, method of physical or mechanical control and disposal area, or the species and stocking rate for biological control. Whole lake fluridone, initial dose 8 ppb maintain above 3 ppb for 90 days

Plant survey method: [x] Rake [x] Visual [ ] Other (specify) Data collected in spring Tier I survey

Aquatic Plant Name	Check if Target Species	Relative Abundance % of Community
Eurasian Watermilfoil	x	50
Curlyleaf pondweed	x	20
Water lily		5
Coontail		5
Variable pondweed		1
Largeleaf pondweed		7
sago pondweed		1
Illinois pondweed		2
Spatterdock		5
Richardsons pondweed		1
small pondweed		1
watershield		1
American elodea		1

INSTRUCTIONS: Whoever treats the lake fills in "Applicant's Signature" unless they are a professional. If they are a professional company who specializes in lake treatment, they should sign on the "Certified Applicant" line.

Applicant Signature	Date
Certified Applicant's Signature	Date

FOR OFFICE ONLY

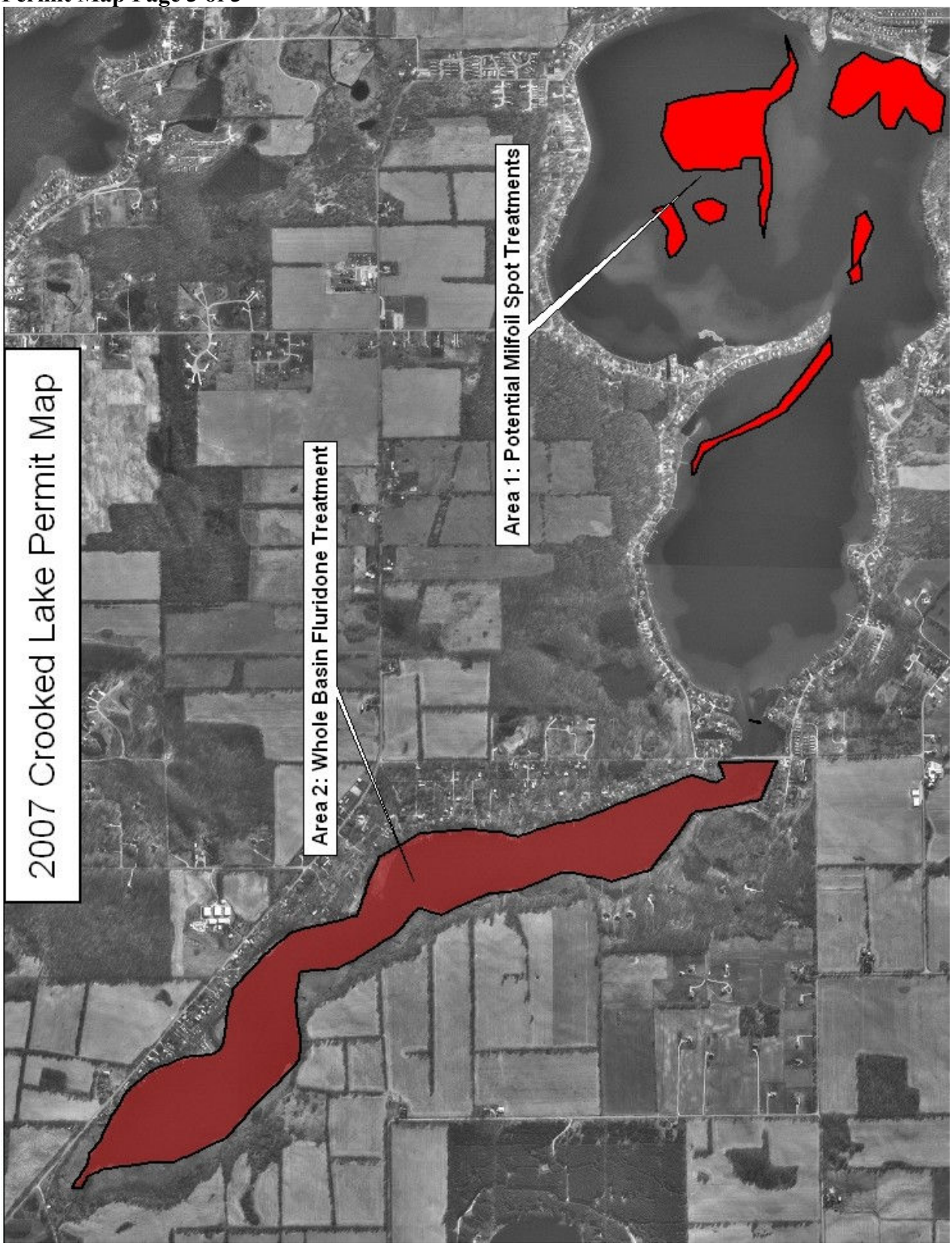
[ ] Approved [ ] Disapproved	Fisheries Staff Specialist
[ ] Approved [ ] Disapproved	Environmental Staff Specialist

Mail check or money order in the amount of $5.00 to:

DEPARTMENT OF NATURAL RESOURCES
DIVISION OF FISH AND WILDLIFE
COMMERCIAL LICENSE CLERK
402 WEST WASHINGTON STREET ROOM W273
INDIANAPOLIS, IN 46204

AQUATIC CONTROL

Permit Map Page 3 of 3



16.4 PUBLIC INPUT QUESTIONARE

Lake Use Survey Lake name_____

Are you a lake property owner? Yes_____ No_____

Are you currently a member of your lake association? Yes ___ No___

How many years have you been at the lake?
2 or less
2 – 5 years
5-10 years
Over 10 years

How do you use the lake (mark all that apply)
___Swimming ___Irrigation
___Boating ___Drinking water
___Fishing ___Other _____

Do you have aquatic plants at your shoreline in nuisance quantities? Yes ___ No ___

Do you currently participate in a weed control project on the lake? Yes ___ No ___

Does aquatic vegetation interfere with your use or enjoyment of the lake? Yes ___ No___
Does the level of vegetation in the lake affect your property values? Yes ___ No ___

Are you in favor of continuing efforts to control vegetation on the lake? Yes ___ No ___

Are you aware that the LARE funds will only apply to work controlling invasive exotic species, and more work may need to be privately funded? Yes ___ No ___

Mark any of these you think are problems on your lake:
___ Too many boats access the lake
___ Use of jet skis on the lake
___ Too much fishing
___ Fish population problem
___ Dredging needed
___ Overuse by nonresidents
___ Too many aquatic plants
___ Not enough aquatic plants
___ Poor water quality
___ Pier/funneling problem

Please add any comments:

_____

_____

16.5 RESOURCES FOR AQUATIC VEGETATION MANAGEMENT

Books
Aquatic Plant Management in Lakes and Reservoirs
Aquatic Plants of Illinois
A Manual of Aquatic Plants
Managing Lakes and Reservoirs
Interactions Between Fish and Aquatic Macrophytes in Inland Waters
Lake and Reservoir Restoration

Societies/Wesites
Aquatic Plant Management Society-apms.org
Midwest Aquatic Plant Management Society-mapms.org
North American Lake Management Society-nalms.org
Inidiana Lake Management Society-indianalakes.org